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The Institute of Vitreous Enamellers

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and

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A New Year's Gift to Industry

The reduction in the price of nickel announced on January 1 has come as an unexpected, but very welcome, New Year's gift to British industry, and will be appreciated by foundrymen both in the ferrous and non-ferrous fields. The reduction in price is all the more surprising at the present time, when commodity prices generally show a tendency to rise, and some of the metal prices in particular are rising rapidly. It has been made possible, however, by the far-sighted policy of the International Nickel Company, which has for years past been working out a policy of more economic production and expanding world markets. This policy, as is well known, has involved intensive research and development programmes, some of the fruits of which, such as the various grades of nickel cast iron, are already well known to industry. The scale on which this research and development policy is pursued has recently been emphasised by the opening of the Mond Nickel Company's research laboratory in Birmingham, which was fully described in our issue of October 22 last. This laboratory co-operates with industry in the solution of metallurgical problems involving the use of nickel and its alloys, and in addition conducts fundamental research which forms the basis of further development in their application. Some idea of the manifold applications of nickel now established can be gained from Mr. Stanley's report on the nickel industry for 1936, which will be considered in our Annual Review Number to be issued on January 21.

It has been the nickel company's aim throughout the period of development of these world markets to maintain the price of nickel at a fixed economic level—a policy much appreciated by many users during times when other metal prices fluctuated widely, even from day to day. A review of the past year shows that this policy has been rigidly pursued even in the boom years; when other metal prices soared, nickel remained at a fixed level. In addition it has been the policy of the company to co-operate with its customers, even to sharing with them the profits resulting from more efficient production and expanding markets, and it is in accordance with this latter policy that the present reduction in price has been made.

This reduction in price will be especially welcome to ironfounders, for, although nickel stands at a price well above the ordinary foundry supplies, such as coke and pig-iron, it is now used in such quantities by British foundrymen that the reduction will mean a substantial saving to the industry as a whole, and especially to the larger producers of alloyed iron castings. The new price of "F" nickel, both as shot and ingots, is £165 per ton, which means a substantial saving for each 1 per cent. added to cast iron. Non-ferrous alloy and steel founders will also appreciate the reduction, especially those engaged in the production of the richer nickel-containing alloys, such as some of the valve alloys, heat-resisting metals, bronzes and corrosion resisting steels.

Nickel to-day enters into alloys of all types used in every branch of engineering, in architecture, and even in jewellery. Expansion in these markets is at the present time continuous, and the consumption of nickel is greater now than ever before. It is hoped that this gesture of goodwill by the nickel company will be repaid by a still greater interest of industry in the metal and its increased utilisation in those many directions in which it can be of assistance in the foundry.

New Materials in Service Applications

Our columns are continually recording new applications of cast iron and related alloys, and such records are of considerable assistance to those who are faced with the problem of choosing the most suitable material for a given application. Every week, engineering works and foundries are faced with the problem of deciding what material to use for a certain application, and whether to make it or whether to buy it from specialists. It may happen that an entirely new machine is being designed, and the foundry, inside or outside the works concerned, has to suggest suitable compositions for a service on which there is little experience. Alternatively, an existing material may be behaving unsatisfactorily, and a substitute needs to be found. Sometimes an engineering firm revises its schedule of materials used to meet a variety of service conditions in a standard design, such as those met with in pumps or compressors. It is a matter of observation that some use one material and some another for conditions not very dissimilar. This is understandable if we remember that first cost plays an important part in the choice, and that the cost of replacement may be more important than the cost of the replaced part, especially if the cost of idle plant is taken into account. Again, it is comparatively easy to

(*Concluded on page* 2)

London Foundrymen to Visit Belgium

A visit to Belgian works is being organised for members of the London Branch of the Institute of British Foundrymen. The outline of the programme is as follows:—The party will leave London on the evening of Wednesday, March 17 and return from Liège on the following Saturday afternoon.

Arrangements have been made to visit the works of Fonderies Nestor Marten at Berchem-les-Bruxells (list of visitors to be submitted), the foundries of S. A. Espérance-Longdoz, Liège and of S. A. John Cockerill, Seraing, near Liège. These visits cover grey iron, steel and non-ferrous practice. Steps are being taken to visit an additional foundry.

An opportunity will be given to visit the old quarters of Liège and one of the outer forts that was used to retard the German invasion in August, 1914. This excursion will take place on the Saturday morning.

The cost of the journey, second class rail and first-class steamer, including hotel accommodation, meals, and gratuities (except porters) will not exceed £8 2s. 6d. Members who intend to take part in this visit are requested to send their name, business connection and address to the hon. secretary of the London Branch, Mr. H. W. Lockwood, of Stewarts and Lloyds, Limited, Winchester House, Old Broad Street, London, E.C.2, as soon as possible. This will greatly facilitate the organisation, particularly as regard the reservation of the best accommodation. Members who send their name at this stage are not definitely committing themselves. Circulars will be sent to each member as soon as final details are settled.

Catalogue Received

Foundry Practice is the title of a collection of bulletins which have been issued by Foundry Services, Limited, of 285, Long Acre, Nechells, Birmingham, 7. These have been reviewed from time to time in our columns. The last issue of the bulletin, enclosed as a loose insert, makes use of the fear complex—a device rather unusual in technical literature, but recognised as a sure selling point for many products. Notice is given of what appears to be a really useful plunger for use with low-melting point alloys.

New Materials in Service Applications

(*Concluded from page* 1)

obtain laboratory records showing the behaviour of various materials under specified conditions of corrosion, heat, vibration, wear and so on, but in service it seldom happens that only one of these has to be encountered. Any or all may operate together, and the result is not always comparable with simple laboratory tests, neither can the result under complex conditions be forecast from such tests. The only solution is to choose a likely material and try it out, using the best advice available, preferably based on both knowledge and experience. Sometimes a genuine service test can be carried out on a laboratory basis, varying one factor at a time, as on automobile engines, for tests on liners, rings, valve seatings, and so on. Even when for a time a variety of materials is found in a given service application, sooner or later one will prove itself to be best, either by virtue of its composition or qualities of superior manufacture. In the manufacture sometimes lies the secret of failure of a material which, from composition and general behaviour elsewhere, might be expected to do well, and this possibility should preclude criticism of the material until such possible errors are ruled out.

Correspondence

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

How Draughtsmen Could Help

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—As a moulder who has given some thought to most subjects appertaining to his craft, I wonder if you would submit for criticism the following scheme for the simplification of foundry estimates.

Briefly the idea is that the draughtsman, working as he does from several isometric views of the job and evolving from them the plan, elevations, and sections necessary for its accurate manufacture, groups his various drawings together, and they eventually arrive in the foundry as a more or less complicated blue-print, from which the foreman has to build up an isometric view of the job before preparing an estimate.

From my experience this building up of the isometric view requires a considerable amount of skill, and necessitates many extra hours' work to safeguard against errors in visualising the job.

It would seem, therefore, that if the draughtsman accompanied his blue-print with an isometric view from a characteristic angle drawn freehand, but roughly to scale, and with only overall dimensions, many hours of thought and over- and under-estimating would be saved. One could imagine a foreman receiving such a sketch and saying immediately "ten feet by five feet by three feet, why the job could be turned over in that big box, and if I cored that bracket out it would be a flat lift."

The internal coring would be another matter, but the main points of cost would be dismissed in a few seconds, since he would be well aware of the length of time required to ram up the job in the box he had in mind.

Yours, etc.,
F. L. TOPHAM.

13, Corring Way, Bolton, Lancs.
January 3, 1937.

An Important Meeting

The attention of readers interested in the question of the degreasing of metals is drawn to an important meeting, which is to be held on January 15 in the Exhibition Room at Imperial Chemical House, Millbank, London, S.W.1, at 8 o'clock, when a Paper is to be read on this subject by Dr. N. R. Hood. The meeting is to be held under the auspices of the Institute of Vitreous Enamellers. Refreshments are being offered by the hosts, and readers desiring an invitation should write to either the Secretary of the Institute or to Room 571 at Imperial Chemical House.

Salt Spray Tests for Stainless Steel

The so-called "salt spray" test is widely used for stainless steel. Recently several bars of cold-rolled chromium-iron alloy (17 per cent. Cr), with surfaces ground smooth and bright, intended for outdoor exposure at an inland location, were exposed in a mist of a 20 per cent. sodium chloride solution for 24 hrs. in work carried out by the U.S. Bureau of Standards. As a result, numerous rust spots appeared at isolated points over the surfaces of the bars. However, after refinishing (during which a layer approximately $\frac{1}{100}$ in. thick was removed from all surfaces) no pitting or rusting whatsoever was observed when the bars were exposed to the same test conditions. The test, in this case, proved that, had the bars been left with the original surface finish, the maximum resistance to corrosion inherent in the material could not have been obtained.

Spelter's Big Rise

BY "ONLOOKER."

Despite the really sensational manner in which the quotation for spelter has climbed, this metal still remains the Cinderella of the metal markets, inasmuch as it stands at the bottom of the list and is allowing lead to gain more and more ground. Just after Christmas spelter jumped up £1 on one market, which made the price £20, but on the same day business in lead was done at £29, so that it still keeps ahead. Spelter undoubtedly looks very cheap by comparison with lead, and speculators have been encouraged to come in quite strongly in the expectation that the gap between the two metals will be narrowed through appreciation in the price of the former. This hope is not founded on a very sound basis, because the demand for lead is on a much better scale than it is for spelter, and, broadly speaking, the lead consuming trades are a good deal busier than those in which zinc is used. Building, cable manufacture and storage batteries, to mention three important industries in which lead is used, are absorbing a considerable tonnage, for weight mounts up very rapidly in the manufacture of their products.

Spelter Demand Limited

Of spelter it may be said that a little goes a long way, at any rate by comparison with lead, for as a constituent of galvanised iron, or even in the manufacture of brass, the proportion of spelter by weight to the whole is not very high. This means that the rate of consumption of spelter, although good, is not spectacular, nor is it likely to be. Production on the other hand is heavy, and moreover it must be borne in mind that spelter is to a great extent a by-product in the production of lead. All the more remarkable is it, therefore, that spelter should have appreciated to the extent it has. Early last year talk of a revival of the Zinc Cartel gave prices a fillip from time to time, but consumers, rightly as events have proved, treated these reports sceptically, and these rallies were shortlived. Certainly speculators have never bought on the strength of such reports, and at the time of writing there seems less likelihood than ever of the producers getting together in this manner. Consumers have their own ideas of what constitutes a right level for this metal, and ever since the quotation passed £15 they have been very reluctant to buy. In this matter manufacturers may be in error, for there has been a revival of talk about the Zinc Cartel, and should anything come of this and an agreement be reached, then spelter is unlikely to go back to £15, at any rate as long as commodities are so much in favour.

No Dependence on U.S.A.

The question of the spelter industry in this country continues to attract a good deal of attention. While it is generally admitted that its retention is altogether desirable, no steps have as yet been taken by the authorities to afford additional protection to the English product. The problem is not an easy one, but its importance cannot be minimised, and it would not be surprising to see some action taken in the fairly near future. Actually comparatively little foreign spelter is purchased by consumers in this country, for the bulk of the metal used is of British or Empire origin, although from time to time during the past year Continental brands have gone into consumption. Opinions about the statistical position of spelter differ a good deal, but there is a growing feeling that an improvement is taking place. In America stocks have certainly come down during the past few months, and the quotation there has hardened accordingly, but owing to the prohibitive tariff the parity in New York is over London, and there cannot be any question of American zinc being exported to Europe.

Developments in the Production of Ingot-Mould Castings*

By ROBERT BALLANTINE

Considerable interest has been aroused in recent years on the subject of ingot-mould castings for use in steelworks, and when Dr. T. Swinden and Mr. G. R. Bolsover, in a Paper presented to the Sheffield Conference of the Institute of British Foundrymen in 1935, put forward data of inestimable value and importance, the steelmaker's case was admirably presented. Arising from the discussion which followed, it was felt by foundrymen that a Paper of a practical nature showing developments in the production of ingot-mould castings would allay the fears of the steelmakers and prove that research and progress in this branch of foundry work is moving forward as rapidly as in other phases of foundry activity.

Those foundrymen trained in other branches of ironfounding naturally visualise the manufacture of ingot-mould castings as being very simple. They are, apparently, heavy pieces of metal of simple design, with uniform sections, in the manufacture of which one might expect ease in every operation; they seem, in fact, from the foundry point of view, to be all that one could wish for. Yet "things are seldom what they seem."

In the first place, these castings must conform to definite standards, and are subject to exacting service. They must withstand extreme variations in temperature and heavy usage, especially when "stickers" require removal. They must be strong enough to undergo hose spraying with water, for cooling when exceptionally hot, and coupled with these qualities the internal finish must be good. The quality of the skin on the inside is important, with a direct bearing on the ultimate lives of ingot moulds.

Uses of Ingot Moulds

Ingot moulds may best be described as permanent moulds for the reception of molten steel, which, on solidifying, is extracted in the form of ingots. The "permanency" will undoubtedly be questioned if the moulds give way early in life. In the Mossend Works of the Fullwood Foundry Company, Limited, specialisation is practised in the manufacture of these castings. Compared with general foundry standards these works may be described as a quantity-production foundry operating on heavy work. The weight of castings made ranges from 2 to 50 tons.

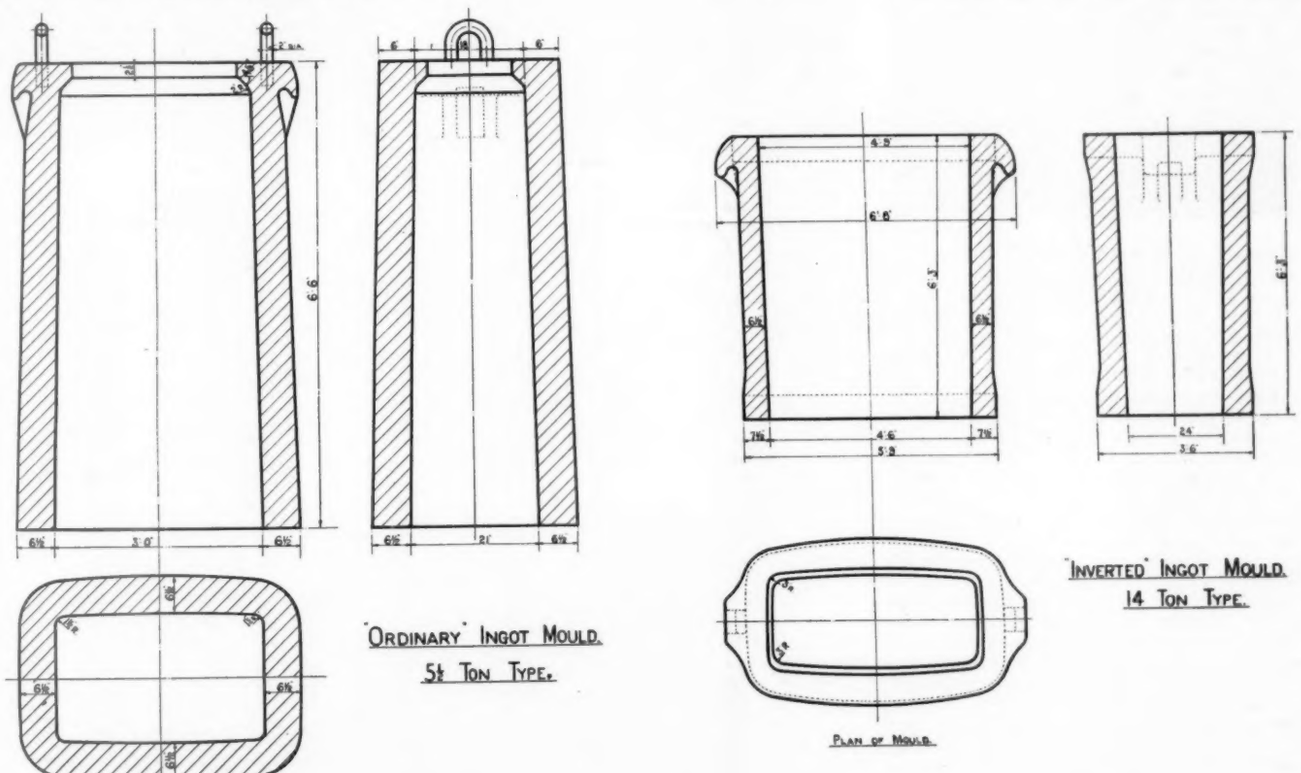

FIG. 1.—ORDINARY TYPE OF 5½-TON INGOT MOULD AND AN INVERTED TYPE OF 14-TON INGOT MOULD.

The lay-out of the Works† lends itself exceedingly well for a continuity of operations. All movements are so arranged that overlapping in their respective cycles does not occur. From receipt of the raw materials until despatch of the finished castings, reasonable control is exercised.

Mould Types

Two types of moulds are manufactured: (1) the common or ordinary, and (2) the inverted. In the first type the top area of the mould is smaller than the bottom, and in the second the top area is larger, as shown in Fig. 1. The 5½-ton mould drawing on the left is that of a common mould with semi-closed top, and the 14-ton mould on the right is of the inverted type. Designs are extremely varied in both cases, and range from the square and rectangles to fluted octagonals and duodecagonals.

Fig. 2 shows a 17-ton inverted mould weighing 26 tons, with the ingot of steel beside it; it is of the duodecagonal type. Fig. 3 shows an octagonal ingot of steel of about 30 tons weight after removal from a mould.

Cores

From the summary already given it will readily be agreed that first-class cores are essential in this type of work. Starting from the shake-out, castings remain inside the foundry from two days to over a week, according to size and weight, so that early chilling of the casting is avoided. After stripping, the castings are loaded up and removed by the work's locomotive to the fettling shop. This covered-in building is a substantial structure suitably equipped with overhead travelling cranes.

The removal of ashes in the cores is the first operation. Internal barrels are not used. The castings are then transferred to the coring benches for removal of the sand and gratings which make up the main core. Pneumatic hammers with long chisels make the removal of core sand a comparatively simple operation. This sand is reclaimed from either end of the casting and falls through diamond-meshed gratings on to a conveyor belt before being elevated to a storage hopper. A travelling hopper takes the used sand by monorail to the core-making department, where it is again stored after the fines have been removed by fan to a settling tank.

A modern plant specially designed for the economic production of cores has been installed, and the only sand used is Scottish rotten rock. A ratio of 5 parts of old to 1 part of new sand is the usual practice. There are no additions of

* A Paper read before the Lancashire Branch of the Institute of British Foundrymen, Mr. J. Hogg presiding.

† FOUNDRY TRADE JOURNAL, April 21, 1932, p. 245.

proprietary binders, nor of coal-dust, saw-dust or other ingredients. Only water is added to give a moisture content averaging 6 per cent. The milling time is 5 min., after which the sand is aerated, and again elevated to a feed hopper, which deposits on to a conveyor belt feeding

FIG. 2.—INVERTED MOULD WEIGHING 26 TONS, WITH ITS INGOT.

direct into the corebox on a 20-in. jolting machine.

It is interesting to note that the green strength of the core sand is low at 4 lbs. per sq. in. A test-piece 2.256 in. in height and 1.128 in. dia. rammed in the Buchanan double-compression apparatus and broken by ordinary spring balance gives this figure (2.1).* For determining dry strength a similar test-piece is used, baked for 2 hrs. at 200 deg. C. and allowed to cool to normal, giving an average strength of 24 lbs. (16 lbs.).* The importance of permeability is outstanding in good core practice for ingot-mould work.

By the modified Richardson apparatus in which the test-piece is rammed and kept in the corebox, the back pressure set up and noted on the water gauge registered 14 in. On the B.C.I.R.A. apparatus the time taken for 2,000 mls. of air to pass through the test-piece in the corebox was 4¼ min. (A.F.A. 126).* On the sieve test, after agitation for 1 hr. the average percentage of sand deposited on the respective sieves was as follows:—

Sieve ..	20	40	70	100	Pan
Per cent..	8	31	42	10	9

Moisture content is checked by Speedy moisture tester on samples taken entering the corebox on the jolter.

Fig. 4 shows a composite sketch in that it gives the lay-out and assembly of the mould and core in part section. A detailed description of core manufacture is essential. The corebox, either in wood or iron, is placed on the jolter, and a bottom lifting plate put in position. The bottom plate takes the contour of the core shape, allowing a slight clearance, an adjustable lifting rod or rods being carried to the top. A suitable tube is then slipped over, and filling with sand commences. At intervals, as shown at A, horizontal grids are placed, these being comparatively light in section and made of steel for re-using. From four to six grids are inserted according to the height of the mould. Frequently, if the body of sand be large, an auxiliary row of short metal cuttings 6 in. long is inserted at the corners and between the gratings.

Perpendicular reinforcements are rarely used. (The inverted core seen in Fig. 5 has not an upright iron in it, and neither have the others). When the core-box is filled with sand, the jolting operation begins. Using 90 lbs. per sq. in. pressure a definite fall in sand is registered. The filling and subsequent operations are repeated, but prior to the finishing jolt, ashes are inserted inside the tube before it is removed.

The effect is most beneficial, the sleeking action of withdrawing the tube is overcome by the settling of the ashes by final jolting. The core-box is slightly opened after a top hand ramming is given, and either the core or the box is removed, dependent on the mould type.

Fig. 5 is a good example of the core used in the first mould shown. As already mentioned no uprights are used, nor is sprigging allowed on any of the corners. This core is not jolted, but all the others are. Great care is exercised in the finishing of these cores. Trowel sleeking prior to blackwashing is not encouraged, but after a liberal supply of blackwash is applied to fully $\frac{1}{16}$ in. sleeking takes place. The final process is a brush-down with water and plumbago additions.

While on this subject of blacking it should be noted that consistency in analyses should be maintained, but blacking of the following approximate analysis, allowing reasonable margins, is highly satisfactory: Moisture, 0.52; volatile matter, 1.48; ash, 8.05; fixed carbon, 89.95; and total sulphur, 0.78 per cent.

A small gum addition is beneficial due to its adhesive qualities.

Good blacking is not in itself enough; its preparation and application is vital. A dual tank mixer, directly coupled to a centrifugal pump, is installed. The tanks are filled with water from the mains to a given capacity, and

FIG. 3.—OCTAGONAL INGOT OF STEEL WEIGHING 30 TONS.

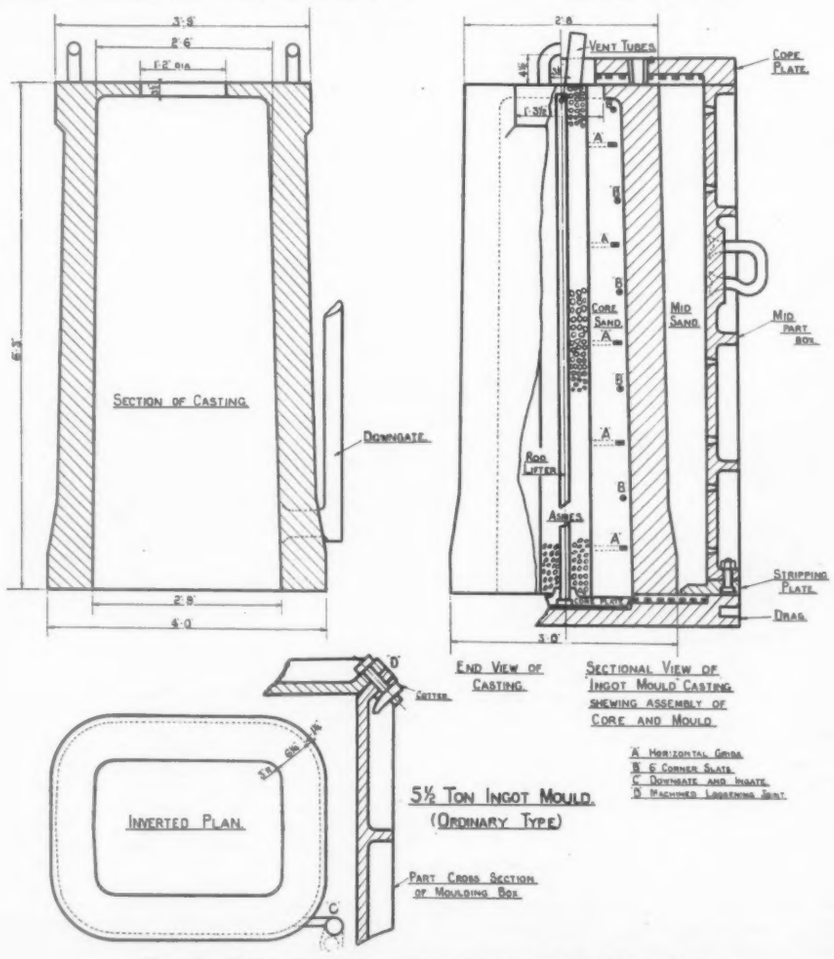

FIG. 4.—COMPOSITE SKETCH OF ORDINARY TYPE 5½-TON MOULD.

* Check figures by Buchanan show wide variations are permissible.

dry blacking is added. A recent development in controlling clay additions has been introduced by additions of clay in powder form. Clay is dried and mechanically pulverised, then added in ratio to the blacking used. Variables in manufacture are a bugbear, and their gradual elimination is desirable if progress is to be maintained.

FIG. 5.—CORE FOR A DUODECAGONAL INGOT MOULD.

Fundaments for Core Production

There are certain features in core manufacture for this class of work which should be noted if satisfactory castings are to be produced:—

(1) The sand must be permeable, otherwise flaking in corners occurs in the larger moulds, due to back pressure into the mould cavity. Ordinarily, release of gas should be through the core into the ashes, gas escaping as the metal rises. The artificial pricking of corners does not appeal as a means to assist venting or to counteract the scaling in corners. Were it convenient to do pricking from the inside of the core to the corners, then the advantages would be apparent.

(2) A liberal coating of blackwash eliminates the tendency to fuse where there are heavy metal thicknesses.

(3) It has been proved in practice that if these cores be dried throughout, the best results are not obtained. Cores dried inside usually lose virtue outside by overheating. Consequently, a curling on the caked blackwash occurs, leaving indentations which must be levelled in the finished casting.

Core Drying

From a study of Fig. 6, which shows a batch of 18 cores being placed on a stove carriage, it will be seen that the question of drying is very important. A normal amount is 20 on one carriage. The cores enter the stove at 10 a.m., are slowly baked for three hours, rising to 450 deg. Fah. (230 deg. C.), and this temperature is maintained until 4 a.m., when the cores are cooled off for removal of the carriage at 6 a.m. for closing and casting. It is the author's experience that cores manufactured with a minimum of handling, and a minimum of disturbance in transit, give the best results. More trouble is caused by strains set up in the cores when in their green state, prior to entering the stoves, than is credited.

Forced drying has been dispensed with in all six stoves. A single fan installed at the chimney base has proved most effective. As a result of inducing a current of hot air through the stoves, fierce drying is not encountered. The effect is observed in a nicely baked core and a cleaner foundry atmosphere. Temperature control is effected by six thermographs of the latest dual-type, giving pen and pointer readings.

FIG. 7.—INVERTED MOULD CORE FOR A 34-TON CASTING.

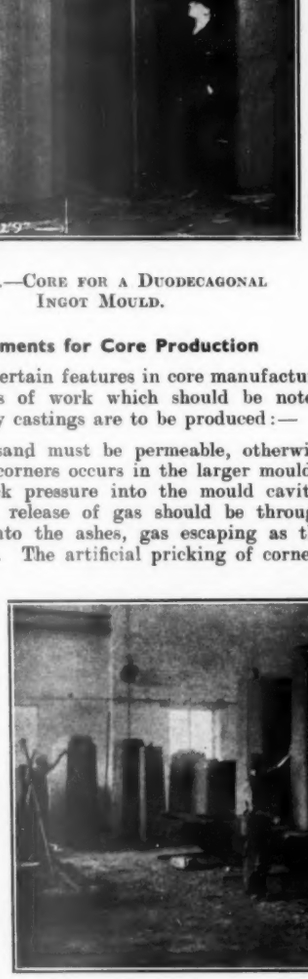

FIG. 6.—BATCH OF 18 CORES ENTERING THE DRYING STOVE.

Fig. 7 shows an inverted mould core (all sand) for producing a 34-ton casting. It has no uprights, and the approximate weight of sand is 4 tons. The sides and ends are slightly cambered, and, moreover, the core is top heavy. Fig. 8 shows a core and mid-part for a 30-ton ordinary mould casting. The mid-parts are of old types, which are being worked out. As in other cores, there are no upright reinforcements. In both cases the drying is from Friday at 5 p.m., and casting takes place about mid-day on Monday.

(To be concluded.)

FIG. 8.—CORE FOR A 25-TON NEW DESIGN.

Canadian Copper and Nickel Production

MR. F. W. FIELD, H.M. Senior Trade Commissioner in Canada and Newfoundland in a Report, No. 655, on economic and commercial conditions in Canada, issued by the Department of Overseas Trade, points out that the mineral industry of Canada, which throughout the depression has proved to be probably the most stable of Canada's basic industries, continues to show improvement. The value of the total production in 1935 (preliminary estimate, $310,162,455) is little short of that of the record year, 1929, when it amounted to more than $310¾ millions.

Nickel output in 1935 was 138,516,240 lbs., worth about $35¼ million—the largest on record and an increase of 7.6 per cent. (in quantity) over 1934. Further important expansion in the nickel industry is forecast by the fact that both the producing companies are engaged upon mine development and plant construction programmes that will add materially to output capacity before the end of the present year.

Copper production of 419,874,920 lbs., valued at approximately $32¼ millions in 1935, reached figures that if predicted 10 or 15 years ago would have been regarded with scepticism. The increase of about 15 per cent. over the 1934 production may be attributed largely to increased demand for nickel—60 per cent. of Canada's copper output being a by-product of nickel mining. Nevertheless, a better price for copper during the year helped the industry greatly.

* H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2. (Price 3s. 6d. net.)

A New Planning System

THE COLOURDEX METHOD

At a meeting of the Sheffield Branch of the Institute of British Foundrymen, on December 3, COMMANDER TREVOR GLENNY read a Paper on "Colourdex Planning and Progress as Applied to Foundry Work."

Commander Glenny stated that Colourdex was different from other methods of control, inasmuch as it was made to suit individual requirements, by which he meant not only individual trades, but the requirements of persons in those trades. This was important, as it had been discovered that no two people regarded any given set of facts in quite the same way. Everyone differed in what they desired to know, and also as to the relative value of the facts shown to them.

The author displayed slides showing photographs of four Colourdex machines. He said that photography was one of the difficulties, as it distorted distances and the camera only had one "eye," which was fixed. The author contended that Colourdex was neither cumbersome nor occupied too much space, as was sometimes asserted. He illustrated an installation in a room of 14 ft. by 13 ft. Not only was there room for the Colourdex machines, but there was plenty of room for the operator, the officials in charge, their desks, and five or six more persons who were continually going in to obtain information from them.

The author explained in detail the construction of a Colourdex machine, and indicated how coloured discs, numbers, etc., were attachable to and detachable from the working positions on the pins. He further explained the head-cards and permanent record hanging tickets.

Rapid Visualisation

He said that every position with its discs and numbers on every pin and bar on a Colourdex machine was visible instantly. The up-and-down movement of the apparatus, combined with the stereoscopic vision of a person's eyes and the movement of his head, enabled that person to run through a tremendous number of pins and data on those pins quite freely. Thus several persons simultaneously could obtain the same or different data from any machine very quickly. The Colourdex apparatus had taken 16 years to perfect. During that time the perfecting had been almost entirely on the mechanical side, which entailed quick manipulation of all Colourdex parts; getting the correct spacing by means of which the eye could find information at high speed; making the apparatus, particularly the pins, to move as freely and as quickly as possible with the minimum of wear; reducing the waste space to the minimum.

A Three-Dimensional System

The author said that Colourdex users were scarcely aware of the bars and pins. They only noticed the information on them. Colourdex simply combined two age-old principles. The first was that colour was the fastest means of finding anything, in that it worked at great speed through the eye to the mind. The second principle recognised was that three dimensions were better than two. Thus, instead of using a two-dimensional card or piece of paper, they used a pin which, joined to the standard, gave them length, breadth and the height of the pin. If they sub-divided the pin itself into positions, all of which could be seen, then they had length, breadth, and divisions of height.

A coloured illustration was then shown of orders divided into months and weeks of delivery. The author said that all portions of the information obtainable from the machine were accessible and visible immediately, while the time taken to add, alter, or remove information had been reduced mechanically to the minimum at present attainable. Possibly even faster working would be obtained later.

Foundry Planning

In regard to planning the progress for the foundry, the author remarked that orders as a rule fell into certain well-known divisions—heavy castings, medium castings, and light castings. Each of those castings was handled in a different way in different sections of the foundry. From the Colourdex point of view a simple colour scheme was given to each of many different groups. A Colourdex typing strip could go into any typewriter and have typed on it the essential information of each individual order obtained and which belonged to its particular colour group. On virtually every installation one of those tiny tickets was sufficient to carry the necessary particulars of any order. The data which these cards should carry were: the foundry's own order number; the name of the firm giving the order; the description of the article or part; the quantity required, and the date when the order was given. From the point of view of progress and planning, however, the date when the order was received was not really necessary. The factor which was definitely needed was the delivery date promised. This latter date was the foundation of the Colourdex application to foundry work as well to many other businesses. Primarily it was necessary to set up coloured divisions on the apparatus, which, in practice, had been found satisfactory for weekly deliveries, each month.

Operation Details

A further slide showed a Colourdex installation split up into orders for delivery under their appropriate colours, week by week for two months. The author stated that as a rule they found that three or four months' survey was a normal requirement. A very simple method existed of relating the unit deliveries, forming a part of one order, to each other on the apparatus. It consisted of using coloured alphabetical discs of the same colour as the little head-card tickets, and putting them on the front of the different unit pins belonging to the same order. Obviously the same method would be used for connecting individual units which were different from each other and which would be attended to in different parts of the foundry, but which must all be delivered together. Having made out the order on the Colourdex head-cards the next thing was to decide when it could be delivered. Certain facts controlled the delivery date, the primary consideration being the demands on the foundry. The Colourdex system allowed every order, or portion of an order, which had been promised for delivery throughout the entire factory for the next three months, to be seen. With this method in operation there was no reasonable excuse for giving a delivery date which it was impossible to keep to. Since Colourdex showed the entire order position at any moment it made any replanning that might be necessary a much simpler and quicker operation than would otherwise be the case. This was possible because the firm whose order must suffer delay could be seen and selected, and since all Colourdex materials—pins, discs, numbers, etc.—were completely mobile, the physical labour of replanning the visible situation to the best advantage was greatly facilitated.

The author illustrated the order pins grouped on various portions of the Colourdex standard according to their delivery dates, and sought to show how much simpler it was to plan, replan and direct the foundry's work when the whole position was visible. He said that foundry planning and progress was more than usually interesting, for it had two fundamentally different arrangements of order pins. That for (*a*) had orders grouped under the week, by which time the order must be cast; and that for (*b*) (the fettling shop pin) had the order pins arranged strictly in numerical sequence. Naturally the vital issue for the foundry was to complete the castings by a certain date. In the fettling shop, however, the questions which recurred frequently: "How are Smith's castings getting on?" and "How is order number so-and-so progressing?" To be able, therefore, to see the progress instantly the arrangement by strict numerical sequence was the better. A very simple means of showing which orders were due for delivery in any particular week was by attaching specified coloured discs for each week on the front of the pins holding orders due for delivery in that week.

Fluctuating Conditions Overcome

The author made a rough drawing of Colourdex methods of showing dates—alternative dates in red leaving the original dates still showing; how weights are shown in a different way from dates; and how a simple colour analogy is used on the printed-disc operations.

Although Colourdex dealt primarily with the ever-changing situation as it occurred from one minute to another in any organisation, permanent and semi-permanent records were also available by the system. A permanent record was kept in a little booklet of 6 to 12 pages which was fitted into the spring at the back of the order pin. Semi-permanent records were kept by a hanging ticket or a series of hanging tickets. The hanging ticket, of material rather similar to the discs and numbers, and as durable, was a simple method of keeping a record about any order or portion of an order, until the order itself was through.

The author made a drawing of a hanging ticket and showed how the operations, when completed, were entered with their dates, and how six or more of the hanging tickets could be filed at the back of the pin with the latest one showing in front.

DISCUSSION

The BRANCH-PRESIDENT (Mr. J. Roxburgh) opened the discussion by remarking that the lecture was one which was somewhat out of the ordinary run of lectures given to the Branch. Personally he felt that the information which Commander Glenny put into his Colourdex system was available in all those foundries that had an appropriate system. For instance, in the foundry which he controlled there were sheets for the various orders and those sheets also served the purpose of progress sheets. Each day a clerk would enter up on the order sheets the dates when a pattern was received, when moulding was started, when the particular casting was cast and the date when fettled. Each day a record of this was sent to the central progress department, so that, generally, they had a copy of all the information which Commander Glenny introduced into the Colourdex system. With regard to the progress of those jobs, naturally, if they were working to full capacity, or if some particular part of their plant was absorbed, then they had to enter fully into the question of delivery. They knew that the delivery dates were of first importance. Commander Glenny grouped his delivery dates according to months, or days or weeks. If a conference sheet was provided for the inclusion of information whereby the orders were grouped according to length of time, and that conference sheet was perused at certain intervals, one was able to visualise the position and revise the dates if they were behind-hand. If one considered an engineering firm which had a large amount of jobbing work, in addition to its engineering requirements, he felt that the difficulties were much greater. For instance, some of the engineering plant at the works with which he was associated was required for delivery in, say, twelve months' time, and it would take twelve months to do it. Sometimes the orders would consist of, say, 75 or 80 separate units, and probably those units would be split into twelve,

twenty or two dozen different sections. The drawings themselves would probably take three or four months before the final copies were ready. As soon as the first copy was issued they started to make the patterns and castings. Such a contract required much time before it was really in production in the shops.

A Pictorial Representation

COMMANDER GLENNY said they were all interested in the production of their factories. They would perhaps walk into the foundry or into the fettling shop and were immediately confronted with some trouble. They wanted to know why certain orders were overdue. They could send scores of pieces of paper out, or they might have conferences, but they did not always get the results they desired. If the progress of the work could be shown in the manner afforded by the Colourdex system the people responsible for the various stages of the work would usually do something in the event of the work being behind schedule. It was true that the Colourdex system would give them exactly the same results as they would eventually get from the circulation of the pieces of paper, but the difference was that the information would be available immediately. Those in charge of factories would find immediately where the trouble lay. Moreover, the visible evidence of the progress made would act as an incentive to the men responsible for the work on the different processes. The employee in charge of the Colourdex system often found that when some delay was shown on the records the man who was really responsible remedied the matter as soon as he saw it. If it was something the man could not deal with, a higher authority would be called in at once. When they had merely a paper in front of them they could not see every order in the factory. They only saw little pieces of orders that were in front of them. In regard to things such as "bottlenecks," a workman might complain that he could not work to schedule unless he had more machines or more men. The Colourdex system would prove whether or not the man had definite grounds for complaint.

The BRANCH-PRESIDENT contended that those concerned were in any case aware when they were behind with their deliveries. They would be fully acquainted with any of the troubles to which the lecturer had referred. Executives or departmental managers naturally studied the questions involved to see what they could possibly do. Sometimes, of course, nothing could be done. Mr. Roxburgh also asked what financial benefits were likely to be derived from the system.

COMMANDER GLENNY replied that the latter point was difficult to answer. Those responsible for the sale of the Colourdex system sent representatives to the firms or individuals concerned, so that those firms or individuals should be acquainted with the facts. They also had to ascertain what results the prospective purchasers wanted to obtain. Some things that might appear irrelevant to him when he visited certain works might be of vital importance to the firm concerned. He had to arrange the system to suit the actual facts as they presented themselves to each individual firm, and to the results that the firm expected. It was important for any firm to know the benefits they could derive from the introduction of the Colourdex system, in order to ascertain if it would be worth while.

The lecturer showed a graph of the results in a big organisation in which the Colourdex system had been introduced. Three major departments of the firm were concerned with the installation. Before the installation 64 per cent. of the entire output of the factory was delayed. He was struck with the courage shown by that firm in admitting this fact. Within the first two weeks of the installation of the Colourdex apparatus the delays fell to 44 per cent. It was obvious that the additional 20 per cent. of delays previously recorded were due to people retaining papers and forgetting various matters. When it was shown that they were late in their sections of the factory, the people affected at first stoutly denied the allegation, but it was proved that the fault was theirs. Then there followed a gradual decline from the 44 per cent. until at the end of the sixth week they were down to 35 per cent. While this progress had been made, some more trouble had been discovered elsewhere, and this increased the figure in the next two weeks to about 45 per cent. Then the fault was corrected, and the figures fell successively until in thirteen weeks the proportion of delays was about 12 per cent. The main factor about the installation of the Colourdex apparatus was that the majority of the orders were all different, and, further, the processes through which they passed often varied between thirty and three.

The BRANCH-PRESIDENT suggested that the firm referred to was aware of the delays in deliveries, and that in order to reduce them it must have increased the production, and that it was mainly due to this fact that the delays had been eliminated.

COMMANDER GLENNY said that that was not the case. He said that the firm did not take on any more men. What they did was to co-ordinate the plan and progress departments in better form.

The BRANCH-PRESIDENT suggested it was originally an inefficient firm.

COMMANDER GLENNY thought it had a great deal of courage in admitting the high proportion of delays.

Influence on Output

MR. F. WHITEHOUSE said he could not determine whether the system was a form of concise works report to the directors or some type of help to those who were planning production. He could not understand how, merely by the introduction of the system, output would go up automatically. He agreed with the Branch-President that there must have been some inefficiency in the firm to which Commander Glenny had referred. Was it suggested that most works were so inefficiently run that those controlling them did not know what was going on inside their own organisations, and that the system would tell them the position they were in and thereby reduce their costs and help them materially to make profits? He noticed that actually the Colourdex system did not help with planning. It merely told the directors that on a given schedule of delivery dates various departments were behind. In his opinion this did not help the firm much. It told them something they already knew. He would also like the lecturer to tell them how the Colourdex system saved money for a firm that was tolerably efficient and where those in charge of departments were thoroughly conversant with the work of their section and the work expected from them at any given time.

Benefits from a Complete View

COMMANDER GLENNY said he was being invited to say that everybody was inefficient. He thought the answer to this question rested with the individual. A man often felt that his organisation could not be bettered. What often happened was that somebody to whom the advantages of Colourdex had been demonstrated introduced them to another firm which was prepared to receive them. Often the head of that firm did not think there was anything particularly wrong with his organisation, but allowed them to inspect it. The best thing to do in that case was to ask the man in control if there was any section of his organisation in which he thought he might get better results. All he (Conmmander Glenny) wanted to know were the facts of the situation. Then he would put the apparatus into operation and allow the firm to judge by the results. It was a great responsibility for him to tell a company that it was inefficient. It was impossible for him to do that. All he could do was to tell them something about a system that was giving people results. Most people preferred to do a job properly rather than badly, and he suggested that he was putting into the hands of people something that would make them capable of doing a thing better than they were doing it. It was much easier to do a job in the best way. The system of the Colourdex apparatus increased efficiency.

MR. WHITEHOUSE suggested that the lecturer claimed that Colourdex was a new and superior system of recording, and that by installing it a firm could do better than it did before.

COMMANDER GLENNY replied that that represented only half the facts. The system showed the progress simultaneously in every department of the factory. The planning department was almost as important as the progress side. The object of planning was to deliver on time. Before anything could be planned the situation in the entire factory must be known at a glance. This information was essential to facilitate delivery of an order on a certain date. If it could not be seen what orders were at the time going through the factory, he did not see how a definite plan could be evolved. He did not know of anybody who would take the trouble of examining all the papers of each order in the factory and analysing them to see how long it would take to execute a new order. That would take weeks to accomplish.

The BRANCH-PRESIDENT suggested that it was necessary to ascertain from the departmental heads what they could do, and for that it would be necessary to have a conference.

The Human Element

Replying to a further point raised by Mr. Whitehouse, COMMANDER GLENNY said he agreed that many people could memorise the immediate situation in their own departments, but he thought that most people would prefer to have a picture before them of the exact state of their work rather than to rely upon their memories.

MR. WHITEHOUSE suggested that Commander Glenny relied for the information given by his method on the human element, and that therefore a mistake was as likely to occur by his method as much as by any other method.

COMMANDER GLENNY said nothing would guarantee the prevention of inaccurate information, but there were many ways in which one could overcome that to a certain extent.

Outstanding Quotations and Orders Received

MR. S. LEETCH said that men in the shops certainly felt they were being harassed a great deal by customers' letters, progress reports and many other things. If a scheme were available to help in the execution of orders it would be advantageous. In the method advocated by Commander Glenny who was the individual who inserted the date of delivery after the inquiries had been made? The majority of orders were the result of inquiries, and when an inquiry came in it went to the foundry. The foundry manager knew fairly well how the work was progressing. He put the delivery date on the sheet. However, there might be, say, three inquiries for a number of locomotive castings. A mistake might be made in estimating so that all three lots came together, and he asked how delivery was to be planned in those circumstances.

A Satisfied User

MR. C. J. DADSWELL said that certain questions would arise in connection with the execution of orders whatever system was in operation at the works. Colourdex was only one method of solving problems. Under any system someone had to say what job was going to take preference. He believed that the foundry with which he was connected was the first to install the Colourdex system. It was installed at their works in an entirely different department after they had tried many systems of planning. After seeing the working of the Colourdex in another department they decided to try it in the foundry. They found the system a good one, the great advantage being that it was visual. One saw the exact position of all orders at a glance.

D

Patterns and Their Relation to Moulding Problems

By S. A. HORTON

(*Concluded from page 505, Vol. 55.*)

Coring-up of the Mould

The commonest error is the print at the base of a core which stands vertical in the mould; a "flat" is cut across the print edge (see Fig. 1). As a core location this is, no doubt, quite satisfactory, but when the moulder commences to assemble the core in the mould he is unable to see the exact position of the core location, which is covered by the body of the core. Only a very slight misplacement is required to cause this casting to be rejected.

The most satisfactory method of locating a vertical core is to have the location strip on the outside of the coreprint (Fig. 2) and the strip to give a definite radial location (Fig. 1). Using

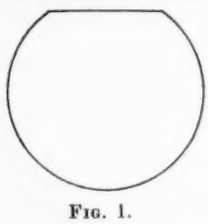

FIG. 1.

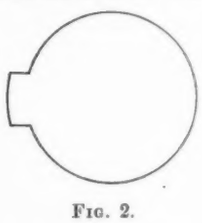

FIG. 2.

this method no trouble is experienced, because the exact position of the core can be seen when the core is assembled.

Patterns made in halves (and this remark also applies to the majority of machine-moulded patterns), the design of which necessitates location strips on the print, give the most satisfactory result. If the strip be placed on the mould joint a core can be assembled in a radial or longitudinal position by this method of location (Fig. 3).

Frequently the strip is placed on the drag portion of the coreprint, but instead of being at the pattern joint it is at right angles to the joint. This method is unsatisfactory because the exact position of the core cannot be maintained within the desired limits.

The question of core drying must also be considered. In certain instances, when the core location is either on the cope or drag portion, special precautions must be taken to prevent the location being fouled by the dryer. If the location is at the core joint the necessary clearance is very easily formed.

Core and Coreprint Tapers

A moulder should not have to dress a core to give the necessary taper before assembling a core in its print. It was no doubt common practice a few years ago for cores to be made without allowance for coreprint taper, but moulding costs do not now allow for unnecessary operations. Apart from the time lost, the location of the core is not as satisfactory with a dressed core as with a core from a corebox. It is, therefore, a definite advantage, both in casting accuracy and moulding cost, to make the corebox with the correct coreprint taper.

Several of the defects mentioned in this section may seem quite trivial, but repeatedly new pattern equipment has to be modified to prevent coring trouble. There are difficulties which would never arise if one moulded entirely from patterns produced in one's own patternshop, but as the faults mentioned above are experienced on patterns supplied, there must be numerous patternshops throughout the country that take little or no notice of the problem of the coring of a mould.

Contraction

Contraction does have a bearing on the dimensional accuracy of the finished casting, and although it has been stated that patternmakers always consider the type of casting the particular pattern is to produce before they fix the contraction allowance, personal experience is that very little of this forethought has been given during the years which the author has had close co-operation with several patternshops.

This experience has been that, with cast-iron jobs, $\frac{1}{8}$ in. to the foot contraction is used, regardless of size and shape. With a non-ferrous or steel job, contraction applicable to the metal is used. The argument used to substantiate this practice is that, if the resultant casting be dimensionally incorrect, the first thing to be done is to check the pattern to trace the error. If the pattern fails to have the allowance for the standard contraction, the patternshop is blamed for the incorrect casting. It is a useless argument, but it is mentioned for what it is worth.

To show the variation in contraction which takes place in the particular metal used in the foundry with which the author is associated, several examples have been taken: Castings without cores, solid plates and strips, castings contracting on to a sea-sand core and castings contracting on to a green-sand core. The castings were carefully measured, and the results have been tabulated. The outside diameter of the castings are somewhat the same, and they must all be within plus or minus the diameter of $\frac{1}{32}$ in. on the rough casting. From this list it is hoped to show that, if the same amount of contraction had been used, several of the castings would have been rejected.

In the author's patternshop there is still difficulty in getting the patternmakers to forget the standard contraction. They believe that they are making the pattern wrongly if it does not correspond to the contraction rule, and if a pattern has to be altered because the casting is oversize, it is always said that the pattern has to be made incorrectly to produce a correct casting.

Casting No. 1 (*Fig.* 4), *Rear Axle Housing.*—The casting contracts on to a sea-sand core. Pattern dia., 15$\frac{3}{32}$ in.; hard casting dia., 14$\frac{31}{32}$ in.; annealed casting dia., 15$\frac{1}{16}$ in.; metal contraction, $\frac{3}{32}$ in.; variation in twelve castings, $\frac{1}{16}$ in.; mechanical vibration.

Casting No. 2 (*Fig.* 4), *Rear Axle Housing.*—The casting contracts on to a sea-sand core. Pattern dia., 13$\frac{3}{8}$ in.; hard casting dia., 13$\frac{5}{8}$ in.; annealed casting dia., 13$\frac{1}{4}$ in.; metal contraction, $\frac{3}{16}$ in.; variation in twelve castings, $\frac{1}{16}$ in.; mechanical vibration.

Casting No. 3 (*Fig.* 5), *Rear Hub.*—The casting contracts on to a 4-in. dia. sea-sand core. Pattern dia., 12$\frac{3}{4}$ in.; hard casting dia., 12$\frac{1}{2}$ in.; annealed casting dia., 12$\frac{5}{8}$ in.; metal contraction, $\frac{1}{8}$ in.; variation in twelve castings, $\frac{1}{32}$ in.; mechanical vibration.

Casting No. 4 (*Fig.* 6), *Brake Drum.*—The casting contracts on to a green-sand core. Pattern dia., 16$\frac{13}{32}$ in.; hard casting dia., 16$\frac{3}{32}$ in.; annealed casting dia., 16$\frac{5}{32}$ in.; metal contraction, $\frac{1}{4}$ in.; variation in twelve castings, $\frac{1}{32}$ in.; mechanical vibration.

Casting No. 5, *Differential Carrier.*—The casting contracts on to a green-sand core. Pattern

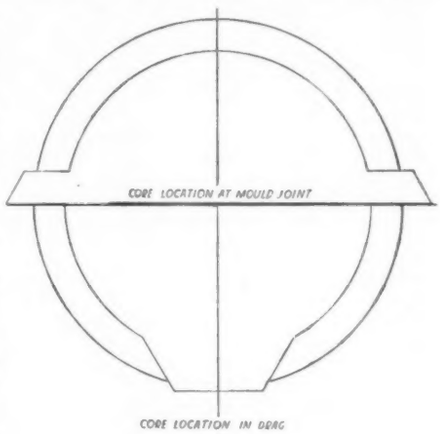

FIG. 3.

dia., 15$\frac{1}{16}$ in.; hard casting dia., 15$\frac{3}{8}$ in.; annealed casting dia., 15$\frac{13}{32}$ in.; metal contraction, $\frac{7}{32}$ in.; variation in twelve castings, $\frac{1}{32}$ in.; mechanical vibration.

Casting No. 6, *Round Plate.*—Solid plate, $\frac{3}{4}$ in. thick; pattern dia., 16$\frac{13}{32}$ in.; hard casting dia., 16$\frac{1}{32}$ in.; annealed casting dia., 16$\frac{5}{32}$ in.; metal contraction, $\frac{1}{4}$ in.; variation in twelve castings, $\frac{1}{16}$ in.; hand vibration.

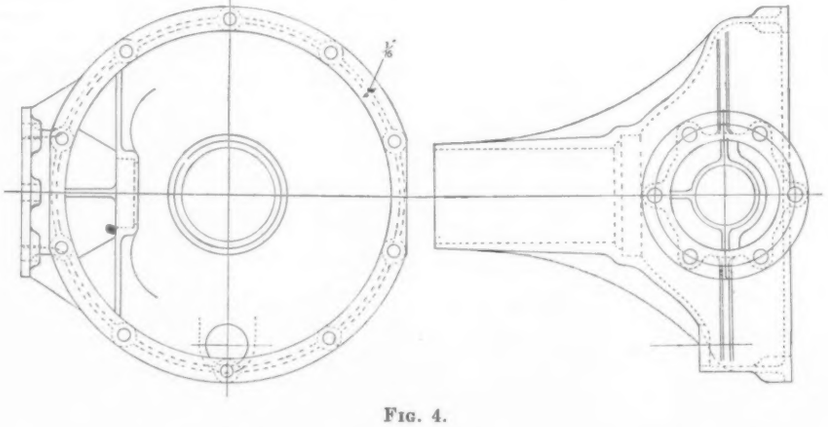

FIG. 4.

Casting No. 7, *Strip.*—Solid strip: Pattern length, 4 ft. 1$\frac{1}{32}$ in.; hard casting length, 3 ft. 11$\frac{31}{32}$ in.; annealed casting length, 4 ft. $\frac{1}{4}$ in.; metal contraction, $\frac{7}{32}$ in.; variation in twelve castings, $\frac{1}{8}$ in.; hand vibration.

All the examples chosen are of circular design. It was purposely arranged for the shapes to be similar to make comparison easier.

It will be noticed that the sea-sand core definitely resists the metal contraction and that

the green-sand core allows the normal contraction. There are many difficulties in persuading the patternshop to tabulate contraction figures for the various types of castings so that they will have reliable information from which to work in future.

This is definitely an internal problem, but it is mentioned in this Paper because it is thought that the variation in metal contraction through

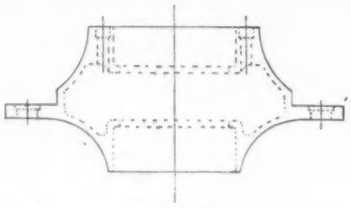

FIG. 5.

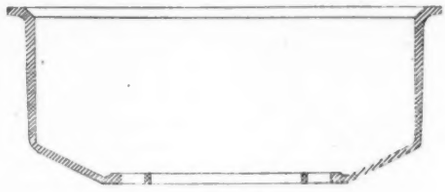

FIG. 6.

details of mould construction is not studied with the seriousness it demands. A certain amount of trial and error is still experienced in arriving at the correct finish size of the rough casting. With constantly changing designs, this is to be expected, but the practice ought only to be used as a last resource, because there is every facility for noting and recording the metal contraction under all conditions and when cast in innumerable varying designs. This information, carefully tabulated, would be of considerable assistance when pattern equipment was being produced in the future.

Generally, the castings produced in the author's shop are not more than 4 ft. in length or width, and their depth is 2 ft., but when the over-all sizes must be controlled within predetermined limits, and in the majority of cases intricate cores have been assembled, the correct allowance for metal contraction must be made. Although it may be a considerable number of years since the first casting was produced, it is suggested that in shops with every advantage of being able constantly to note and record metal contraction on the numerous designs of castings, only 50 per cent. could produce a tabulated contraction record if requested.

Dimensional Accuracy and General Finish

The details of pattern production mentioned in this section of the Paper are of primary importance. The majority of castings manufactured to-day are machined by quantity production methods. They must therefore be correct to a standard of accuracy which has never been demanded previously. Everybody is aware of the high standard demanded by the average machine-shop inspection department. To fulfil the necessary requirements, rough castings must conform to drawing dimensions within unreasonable limits.

The point it seems desirable to emphasise is that although a pattern may be correct to drawing and produced to mould in what is thought to be a satisfactory manner, machinable castings are not obtained. For the purpose of this Paper a machinable casting is one which will locate in the various predetermined location points of the tooling equipment designed for the machining of this particular casting, and be correct to drawing when the machining operations are completed. What is meant can best be illustrated by explaining the difficulties recently experienced with a steering box casting. The foundry was requested to produce castings for a steering box, the jig locations being marked on the drawing from which the pattern equipment was produced. It was decided to joint the pattern through the centre line of the main bore as shown in Fig. 7. The section beneath the quadrant arm casing was cored out, and when completed the pattern was moulded on a plate and appeared to be quite satisfactory as a moulding proposition. It was noticed that the location points were on each half of the pattern, but it was expected that these could be controlled.

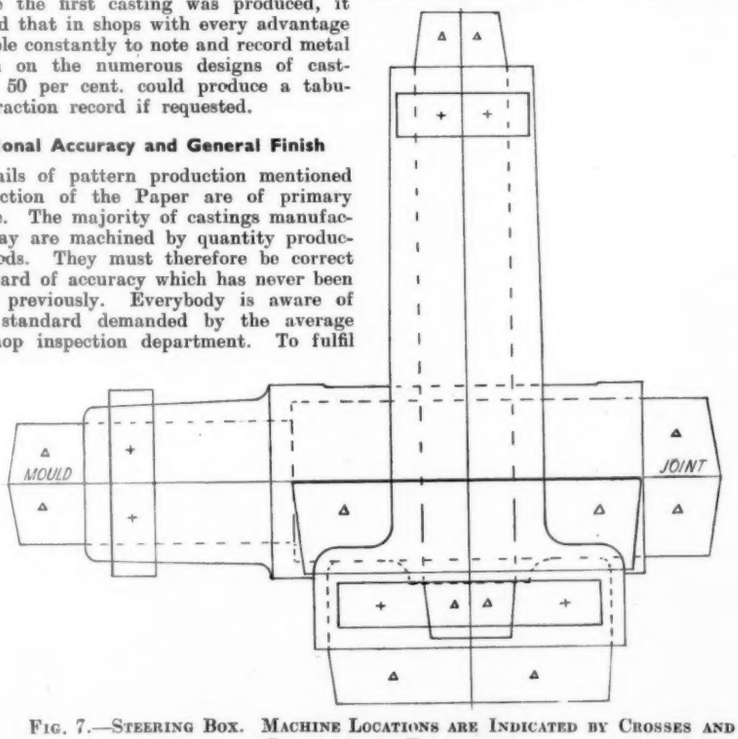

FIG. 7.—STEERING BOX. MACHINE LOCATIONS ARE INDICATED BY CROSSES AND COREPRINTS BY TRIANGLES.

The castings produced were quite satisfactory and considered to be of standard finish. When machining operations commenced, it was stated that no two castings were alike, and that if machining operations were continued the machined rejections would be abnormally high.

The method of machining was as follows:—The machine, an Archdale automatic, had six stations, on each of which was a casting location jig on which the castings were located. These stations revolved and made six stops in one revolution. At each stop a set operation was performed, and when a casting had made one revolution of the machine the whole machining operations were completed. From this description of the machining equipment it will be understood that the castings had to be extremely accurate and consistent in general shape.

On the first machining run 25 per cent. of the castings machined were rejected, as the main and trunnion bores failed to clean. In an endeavour to check this high rejection figure, the patterns were inspected and found to be correct. Location fixtures similar to the machine locations were then made to gauge the position of the two bores in relation to the location points. It was proved that slight "swells" on the trunnion bore, caused by variation in ramming, and slight cross joints aggravated the two points of location on the trunnion bore, and the one on the main bore adversely affected the machining location. With these errors controlled, the rejection percentage was reduced to approximately 10 per cent. This was not considered satisfactory, and when the whole position was reviewed by the foundry executive it was decided to make new pattern equipment.

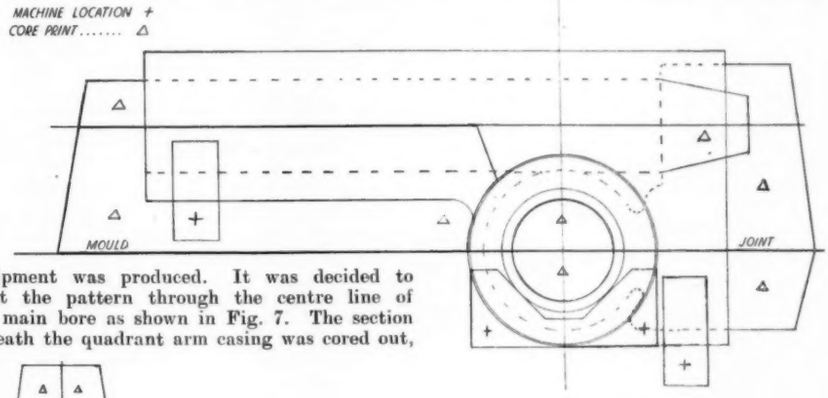

FIG. 8.

This equipment was again jointed on the main bore centre line as shown in Fig. 8, but at 90 deg. to the first pattern made. A core was placed beneath the trunnion boss and the pattern was mounted on plates. It will be noticed that now the three location points are on the same half of the plates, so that it is impossible for cross jointing to affect the location, and the possibility of "swells" on the trunnion boss are almost entirely eliminated. The castings from this pattern have given complete satisfaction. The error of bores not cleaning was overcome and material rejections (blow-holes) are now the only complaint.

Recently the machinist has demanded a standard of general accuracy for rough castings that the foundry cannot meet, unless the patternshop is prepared to co-operate. This calls for specialisation within the craft, and at present it appears that patternmakers are unaware of this new demand. In recent years foundry technique has advanced tremendously, but the patternshop does not seem to have advanced accordingly. Repeatedly, when a blueprint of a new design is submitted for pattern production, the patternshop is searched for patterns similar in design. If the pattern found has been made

ten years, the new pattern called for is made similar to the old one. This, it is suggested, is wrong. Every new design should be intelligently studied and the foundry executive consulted. It is the casting which is the saleable commodity, and everything necessary to a successful product should be put into its production.

Spring Shackle

Fig. 9 shows another pattern equipment which has been altered to produce machinable castings. The machine shop had difficulty in maintaining the correct thickness of the rib when machining from a location which engaged in the spherical bore. Two patterns which formed the spherical bore were mounted on a coreprint; both patterns

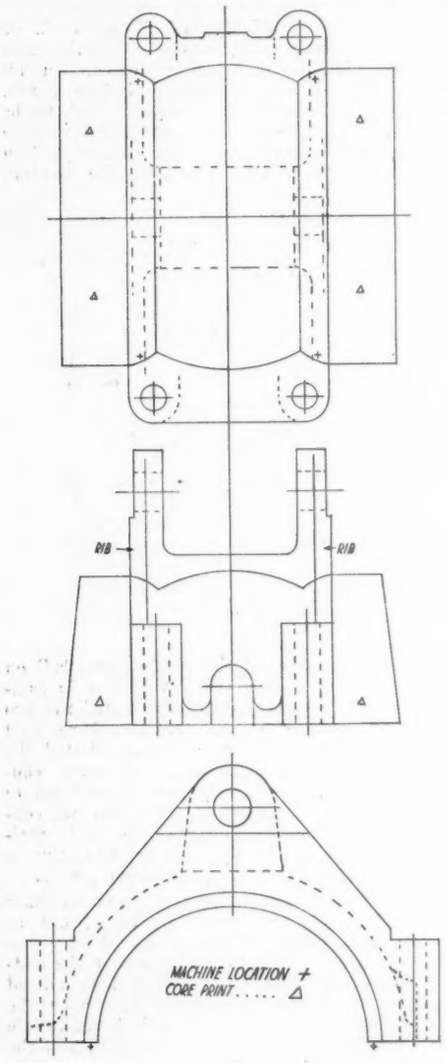

FIG. 9.

and corebox were well constructed, the core being a good fit in the print and the castings produced appeared quite satisfactory.

When the castings were located for machining the position of the two ribs varied, and when machined there was no consistency in the finished thickness of each rib. In an endeavour to overcome this defect every care was taken when assembling the core, but the machining results were similar.

It was eventually decided to make another set of patterns (Fig. 10), the cored portion this time to be moulded. The patterns were mounted on a plate and the opposite side made to form the spherical bore. Castings produced from these patterns have given complete satisfaction, and the ribs when machined have been consistent to drawing size.

Difficulty is frequently experienced in maintaining the correct amount of material around a machined hole when there is little difference between the size of the hole and the boss facing. For example, with 1 in. dia. hole and 1¼ in. dia. boss facing, the hole has only to be slightly out of centre to create a visible error, and if there is a series of similar holes on any surface it gives an unsightly appearance. One of several factors can operate to affect the position of the machined hole. If the diameter of the boss is increased slightly the appearance of the completed casting would be improved, and, if desired, there is sufficient material around the boss diameter to allow for it to be machined to the required size.

Casting Identification

Casting identification would be considerably simplified if a little thought were used before the necessary symbols were placed on the pattern. Usually symbols are made of stamped aluminium or brass, but these materials are easily mutilated if placed in an exposed position, and frequently they are fastened on the pattern surface. It is suggested that whenever possible the symbol should be placed in a recess in the pattern surface, the top face of the symbol to be level with the pattern surface. It is then protected to a certain extent and if there be sufficient taper on the symbol, there would be a visible identification on the castings.

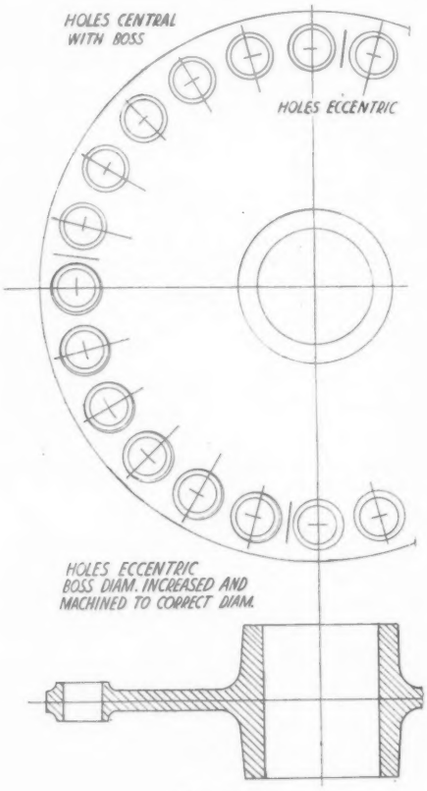

FIG. 10.

Frequently, when the symbol is placed on the pattern surface it becomes flattened out by moulding operations and carelessness, and when the castings are examined before despatch, it is almost impossible correctly to read the symbol as cast.

In conclusion the author wishes to thank the directors of Ley's Malleable Castings Company, Limited, for permission to use certain equipment for illustration purposes and to publish details of moulding operations.

Notes from the Branches

Scottish Branch.—A meeting was held at the Royal Technical College, Glasgow, on December 12, at which Mr. F. Hudson (Branch-President) presided. The CHAIRMAN welcomed Mr. H. Winterton (President of the Institute) and Mr. T. Makemson (general secretary), who were paying official visits. He asked Mr. Winterton to present the Institute's diploma, which had been awarded to Mr. H. McGrandle for his Paper "Metal Moulds for Cast Iron,"* which was presented last session.

MR. WINTERTON said it was a great pleasure to present the diploma which Mr. McGrandle had won. He hoped to see him achieving greater things in the future.

In June he had the honour of thanking the Institute in general for the honour conferred on him by electing him to the Presidency of the Institute, and he now wished to thank all his colleagues in the Scottish Branch. He hoped the Institute would be able to do something for the industry and that its membership would mean much to them. The General Council were at the moment trying to do this, and he had been impressed with the whole-hearted approbation of the Scottish Branch by the Council; the Scottish was one of the best managed Branches in the Institute. He wished to congratulate the Falkirk section on its progress, and hoped it would become a very important section of the Institute.

MR. T. MAKEMSON said this year the Branch had played a most important part in the Institute—it had provided a President. The annual conference was very well managed and conducted, and he wished to thank the conference officials and the secretary. At this time of year he usually made an approximate census of the membership, and this year there were about 1,930 members, which was a record in the history of the Institute. In recent years the Institute had extended its activities without interfering with the work of the Branches. Work had been done on national matters, such as the British Standards Institution. There were the technical committee and sub-committees, which, of course, take some time to show results, but they are now beginning to show results and bringing modern research to the foundry. Educational work was also fostered by the Branches, and in this respect the Scottish Branch had done good work in connection with the Stow College. These activities were likely to increase in their number, but they would not interfere with the ordinary activities of the Institute. No organisation was more dependent upon the members than the Institute, and its growth depended on the number of members and the support they give. He asked for a continuance and intensification of that help for the good of the foundry industry as a whole.

The CHAIRMAN, in proposing a vote of thanks to Mr. Winterton and Mr. Makemson for having come to the meeting, said that at the beginning of the session the Branch membership was 273, and he had expected the number would have exceeded 300 by that meeting. They were, however, seven short of that number, and he hoped everyone would do his best to secure this number of new members before the end of the session.

He then called upon Mr. W. H. Smith to read his Paper, "Mould and Core Drying by Modern Methods."

Burnley Section.—The Annual Social, to be held on January 9, will commence at 5 p.m. and not 7.15 p.m. as stated in our last week's issue.

The meeting of the Lancashire Branch, which was scheduled for January 9, has been postponed to a later date.

* FOUNDRY TRADE JOURNAL, January 16, 1936, p. 74.

Vitreous Enamelling in Germany*

By Dr. H. J. KARMAUS (Berlin)

The art of enamelling is of great antiquity, and, from objects which have been found, can be traced through the ancient civilisations to prehistoric times. This, however, is not so with the vitreous enamelling industry, since in Germany this has a history which, according to the records, dates back only to the latter half of the 18th century. The first works of this kind were engaged in the enamelling of cast-iron utensils and stoves. In the 19th century, enamelling was applied to many other articles, but it is only since the war that the vitreous enamelling industry has gained such a sure foothold in the economic life of the German nation as to enable one to say without exaggeration that any article can now be obtained in the enamelled form.

At the present time, enamel ware is just as universally popular and enjoys just as many applications as the equally well-liked but more expensive chromium plating. For this, thanks are due to the many investigations and researches carried out under the auspices of the vitreous enamelling industry and to the countless new processes which have been developed and have made vitreous enamel what it is to-day.

It is the purpose of this Paper to throw some light on the present situation of the vitreous enamelling industry in Germany. The more recent raw materials will be referred to in succession; an account will be given of modern accessory agents whereby defects of manufacture can be minimised and costs reduced; recent enamelling practice will be discussed, and finally new fields of application of vitreous enamel will be enumerated.

German Raw Materials

In previous years, Scandinavian felspar was employed almost exclusively in Germany for the production of vitreous enamel, but recently German felspars have also been used with successful results. An example of this is a felspar found in Thuringia and known in the trade as "Habera Kalifeldspat" (Habera potash felspar). It has the following chemical composition: H_2O, 0.97; SiO_2, 69.4; Al_2O_3, 17.96; Fe_2O_3, 0.05; CaO, 1.05; K_2O, 10.00; and Na_2O, 0.65 per cent. Parallel tests made with this German felspar and with Scandinavian felspar have shown that the use of German felspars is not disadvantageous, but that even certain advantages are secured. The same applies to German felspars found in the Saar and elsewhere.

The clay employed as mill additions since the commencement of the industry has been extensively replaced in recent years by a colloid obtainable on the market under the name of "Ultra-Sil." This product exerts an effect reminiscent of that of bentonite, and has a very excellent floating action, practically no settling of the enamel taking place. "Ultra-Sil" is added to the mill in the same way as clay, but only 0.2 to 1 per cent. is required. The resulting enamels have a particularly intensive colour effect, and this product, of which there are a number of special varieties, also possesses other favourable properties as compared with clay.

The numerous opacifiers, such as antimony, titanium, zirconium and cerium compounds, constantly on the market, besides those which have long been found to be reliable, and all the numerous methods of obtaining a light-coloured sheet-iron ground coat, however interesting they may be, will be omitted from this review, although a brief reference may be made to the opacifier "G.T.M. Kreidl," which is protected in all countries. The opacity is not produced in this case by constituents which are only sparingly soluble in the enamel, but by microscopically small bubbles of gas. The results obtained in recent years with the different varieties of this gas opacifier are so astonishing that it would certainly repay any enamelling works to give these opacifiers their serious attention.

In order to eliminate, to a considerable extent, the relatively expensive borax from the enamel mixes, successful application has been made of an alkali borosilicate glass in a finely powdered form. Two-thirds of the borax content of the ground coat are replaced by one-third of this new product which is marketed under the name of "Sioglur," and in the cover coat half the borax content is replaced by "Sioglur." Since this alkali borosilicate glass has practically no loss on fusion, it is possible to use half the weights. Thus, 30 parts of borax are replaced by 15 parts of borax and by 7.5 parts of "Sioglur." The results of this replacement of the borax are that the enamel is whiter and there is a saving in borax, and in addition considerable advantages are secured for special purposes. In Germany, there is a growing conviction that a borax content of 10 per cent. in the ground coat and one of 7 per cent. in the cover coat should be regarded as adequate.

Lead Elimination and Colour Control

The German chemical industry has also made some progress in connection with the colours employed in the enamel industry. Many poisonous oxide colours formerly employed have been replaced by safe colours, whilst in addition the intensity and productivity have been considerably increased, but this, again, cannot be discussed in the scope of the present review. Reference will merely be made to a special kind of colours, the addition of which in the mill enables white powder enamels to be produced in any desired bright colours. It is therefore unnecessary to fuse each tint separately in the smelting furnace, whereby it is easy to incur the risk of not always obtaining the same tint, but ordinary white powder enamels are used and 2 or 3 per cent. of these new colours are added in the mill. The principal field of application of these pastel coloured porcelain enamels is the production of coloured baths and other sanitary utensils.

It is also necessary to mention the progress achieved in the manufacture of sheet iron for enamelling. Particularly in regard to Armco sheet iron, improved methods of manufacture are stated to have excluded the possibility of accidental variations in the composition and quality of the sheets, and it is thus possible to have at any time a perfectly uniform and reliable special sheet iron for enamelling.

A Rust Preventive

Finally, as the most recent innovation in this field, reference should be made to the anti-rust salt "Rostex." An amount of only 0.1 per cent. of this product, which can be obtained on the market, when added to ground-coat slip, is sufficient definitely to prevent the formation of the troublesome rust spots with their frequent comet-like tails, a defect well known in the cast-iron enamelling industry. It is no longer necessary to coat articles a second time with cover enamel and fuse again in order to prevent the defects showing through. This anti-rust agent has also been found excellent in another field, for if, when pickling, 0.25 to 0.5 per cent. of this "Rostex" is added to the swilling water, sheet-iron articles will not rust either in water or when dried slowly in the air, but on the contrary will remain as bright as silver even if they have to stand for some time before enamelling. An important advantageous result of this is the elimination of the always imperfect drying of the wet sheet-iron ware which was generally carried out in special stoves. In addition, the ground coat grips better after this treatment.

Modern Appliances

Attention will now be given to the actual manufacturing processes to gain a description of the modern appliances and equipment which enable manufacturing faults to be eliminated as far as possible, and costs to be reduced. First of all, it will be necessary to say a few words regarding the weighing of the various ingredients. The permissible errors of weighing should be only 0.1 per cent. for each ingredient. Regarding the various weighing machines marketed for this purpose, the following systems may be distinguished: decimal scales, steelyards, batch scales with a special set of steelyard weights for each ingredient and automatic weighing machines travelling below the bunkers on a narrow-gauge track.

Not only the weighing machines, but also the mixing machines have been continually improved in the course of the last few years. A distinction may be made between cylinder, trough and pan mixers. The requirements which modern mixing machines are expected to satisfy are that they should not merely well mix the raw materials of the enamel, but should also thoroughly crush the lumps (of soda, saltpetre, etc.). It is also necessary to see that the machines mix without the formation of dust and can be charged and discharged without dust. The German vitreous enamel industry has had reliable weighing machines and good mixing machines at its disposal for more than ten years, so that there is no need to describe them in detail. It is likewise unnecessary to give a detailed description of the universally employed rotary oil-fired enamel melting furnaces.

Novel Process for Drying Frits

The drying of the wet frits which are later ground into the enamel powders will be discussed at greater length. Appliances successfully used in the chemical industry for the drying of wet materials have not proved serviceable in the enamel industry because the sharp-edged frits produce excessive wear of the metal parts with which they come into contact, and the milled powders are thus contaminated with particles of metal. A method of drying covered by the German patent 496,973 is very successful in operation. In this process a cylinder for drying the granulated enamel is mounted at the flue

* A Paper presented on behalf of the Verein Deutscher Emaillefachleute to The Institute of Vitreous Enamellers at a meeting held in London, Mr. V. C. Faulkner presiding.

end of the rotary melting furnace and is heated directly or indirectly by the flue gas of the furnace.

Another new process disclosed by the German patent 620,271 concerns the dry cooling of enamel. In principle, the process consists in allowing the thin stream of molten enamel, as it flows from the furnace, to be rolled out fine between two cooled rollers, the enamel only losing so much heat to the rollers or to the cooling water flowing through them that the rolled enamel is no longer fluid and no longer sticks together in the collector. To enable large quantities of enamel to be cooled in the device below the tapping hole, the entire apparatus is reciprocated in the direction of the rollers.

The enamel is thus distributed over a considerable portion of the rollers and is rolled out into a broader band than if the stream of enamel impinged always on the same part of the rollers. By mounting a pair of crushing rollers below the cooling rollers, the previously cooled enamel is obtained in the form of small pieces and requires less storage space than if the band were kept in large pieces.

Mill Room Practice

Regarding the roller mills for crushing the enamel frits, there are few innovations to report from the last few years. The method of indicating the milling period by the time is, however, being discarded. Since stoppages can readily occur in the drive, it is advisable to mount revolution counters on the mills for determining the milling period. Roller bearings also are highly to be recommended, since they reduce the power consumption by about 40 per cent. over ordinary bearings. There is also a saving in lubricant, since roller bearings only require lubricating twice a year.

The methods adopted for applying the enamel to the articles and for drying the enamel after application have not changed much, if at all, in recent times. Likewise, the advances in the improvement of fusion accessories must be common knowledge. All the necessary fusion equipment, such as supports, blades, perrits, etc., are now made of non-scaling, highly heat-resisting steel. There is also no necessity to discuss the various muffle charging devices and the manipulation of the racks.

Furnace Economies

For reducing the considerable heat consumption caused by the poor thermal conductivity of the ordinary fireclay muffles, it has recently become more general to employ slabs burnt from powdered carborundum (SiC) with clay as binding agent. According to measurements which have been made, the saving of fuel in the case of muffle slabs containing 10 per cent. of clay is stated to be 25 per cent., while in the case of slabs containing up to 30 per cent. of clay, it is 10 to 15 per cent. Following the example set by the ceramic industry, a commencement has been made in the last ten years with the construction of tunnel or continuous furnaces for use in the vitreous enamelling industry.

Briefly, the principle is that the ware to be fused is passed continuously from a pre-heated zone through a fusion zone, and then to a cooling zone. The progress made in this connection and also in connection with electrical enamelling furnaces, however interesting, may be passed over, although these types of furnaces have been developed very considerably in the last few years and are being employed on an ever increasing scale.

Temperature Control

Reference will merely be made to the importance of temperature measurements on muffle furnaces. Thermocouple pyrometers do not give particularly accurate values, since the temperature fluctuations caused by the introduction of the ware are equalised too much in this method of measurement by the heat retained by the walls of the muffle. Optical pyrometers, however, give results corresponding to the actual temperature fluctuations.

Temporary measurements are made by sighting the back of the muffle through the door opening. For continuous measurements, which are in any event advisable, a tube of refractory material, closed at one end, which assumes the temperature of the furnace, is placed in the back wall of the muffle or at some other suitable place, and the pyrometer is focused on the closed end. The results thus obtained may be recorded if a recording pyrometer is used, but this is only important for works supervision.

The best method is to mount an indicating instrument having a large clock-like dial in the vicinity of each muffle. On introducing a fresh charge, the temperature will fall according to the size and nature of the charge by about 50 deg. C. in the case of sheet-iron articles and by 100 to 150 deg. C. in the case of castings. The temperature slowly rises again and as soon as the characteristic temperature of the enamel in question is attained, the latter will have been correctly fused.

Enamelling Processes

Many problems which have been experienced must unfortunately be regarded as still unsolved from the point of view of the industry. Thus, it has not yet been possible to discover a white sheet-iron ground coat, a leadless enamel ground coat for cast iron or a really serviceable and economical method of de-enamelling defective sheet-iron articles. The attempts made in this connection may therefore be omitted from consideration.

Quite a novel process, which is protected by the German patent 548,850, has been developed for the application of wet enamel. The finely divided enamel material is suspended in a mist of liquid in a closed chamber and the articles to be coated are introduced into this chamber, after having been previously cooled to as low a temperature as possible in order to promote the condensation of the mist, and hence the deposition of the finely divided enamel on the surface of the articles. Since the application or deposition of the enamel takes place without the action of any pressure, the coating of enamel is more even and thinner than could ever be produced by manual application. In particular, projecting ledges and corners are coated with a uniformity which otherwise could only be attained with difficulty, if at all.

According to the German patent 488,840, for producing marbled, mottled, grained or other variegated enamels on cast or sheet iron, the pattern enamel colours are applied in a mottled, veined or similar manner on a white or coloured support, and are then blurred or squeezed by means of a flexible, transparent, very smooth non-porous cover; for example, oiled paper, parchment paper, celluloid or the like. By means of this invention it is possible to produce mottled or similar enamels in any desired colours and on every conceivable kind of article, whether cast iron or sheet iron, with astonishingly simple means and without any particular skill as compared with the older methods.

Matt Enamels

Since enamels having a matt or dull finish have recently come into extensive use, this method of manufacture will be discussed rather more fully. The general opinion is that for producing a dull enamel it is only necessary to use copious amounts of pre-opacifiers, and also to add excess of opacifiers in the mill. In particular, antimony oxide may be melted in large quantities or even 20 per cent. of kaolin may be added in the mill. If only certain parts are to have a dull finish, such parts may be etched with hydrofluoric acid or portions of the finished enamel coating may be roughened by sand-blasting. Both these methods may be carried out without the application of heat. If an additional fusion can be effected, portions may be given a dull finish by dusting on infusible substances, for example, magnesium oxide, opacifying agents or finely ground quartz, or by applying solutions of infusible salts, for example, magnesium sulphate, to the places concerned by means of a brush.

According to recent experience, a much more even and smooth dull finish is produced on enamel by dipping articles coated with ordinary enamel into strongly alkaline solutions, and for this purpose solutions of caustic alkalis, sodium phosphate, etc., are suitable. The articles immersed in these solutions are afterwards rinsed with water and possibly greased or oiled somewhat. Such a method is applicable to all white or coloured enamels. In addition, from the point of view of works practice, the use of aqueous alkali solutions is simpler than that of sand-blasting or using hydrofluoric acid with the application of an addition fusion operation. Compounds with a high content of silica, alumina or other substances which are difficult to attack do not offer any obstruction to the action of alkaline solutions, since, of course, any such compounds can be etched in this way. Any enamel can be provided with a dull finish by concentrating and increasing the Na_2O content of the etching solution.

Quality Improvement

Finally, mention may be made of a method of improving the quality of enamel. In order to prevent hair lines and other defects which appear in the course of time in heated enamel apparatus, it is proposed according to the German patent 572,301 to add silicon, silicides of the heavy metals, or silicon carbide to the enamel. The advantage afforded by this process is stated to be that the addition of silicon prevents the occurrence of strain and local accumulation of heat in the enamel, both during the process of manufacture and also when the finished enamelled articles are in use. As an example, it is stated that 8 per cent. by weight of powdered silicon, previously purified by treatment with acid, is added to the enamel slip employed for coating parts of apparatus.

The foregoing account of the more recent enamelling methods by no means exhausts the improvements which have been made, and it has only been possible to select just a few processes. The aim of the German vitreous enamelling industry is to improve continuously the quality of the enamel. Now that the German vitreous enamelling industry has succeeded in eliminating lead-containing enamels for all purposes, qualified representatives of the Verein Deutscher Emailfachleute are chiefly engaged in perfecting the methods of testing enamelled articles.

These tests will concern more particularly the mechanical strength, the heat-resisting properties, the examination of the lustre, opacity and tint, and the resistance of enamelled surfaces to attack by chemicals. All these properties will have to be defined numerically in later years. Much valuable work has already been accomplished in this direction, but the investigations have not yet approached their completion sufficiently to establish definite standard methods.

[Field of Application

Nothing shows the recent progress in the vitreous enamel industry in Germany so clearly as an enumeration of the articles for which enamelling has been used in the past few years. Many German motor-car manufacturers are now enamelling exhaust pipes and elbow pipes which otherwise are easily corroded by the hot exhaust gases. Enamelled brewery tanks have become so well established in the last few years that in Germany alone there are 4 or 5 works engaged in their manufacture.

It is a well-known fact that particular attention is being paid nowadays to the satisfactory lighting of works, factories and streets, and, here, enamelled reflectors, in addition to withstanding the weather well and being cheap in price, increase the lighting efficiency as compared with other materials. From the tropics come many reports confirming the good service given by enamelled railway carriages, which are lined externally with enamelled plates and do not have to be put out of service for re-painting.

Airless Shot-Blasting

DISCUSSIONS OF MODERN CLEANING METHOD

During the present session both the Midland and the Northern Sections of The Institute of Vitreous Enamellers have discussed MR. H. BOARDMAN'S Paper on "Developments of Airless Shot Blasting" (FOUNDRY TRADE JOURNAL, December 3, 1936). We append a report of the two meetings.

NORTHERN SECTION

The CHAIRMAN (Mr. H. Whittaker) said that members were agreed that the old form of sand-blasting was a bugbear of vitreous enamelling, and was one of the major costs, being comparable with labour costs, cost of enamel, etc. Sand-blasting was not merely expensive, but also very troublesome. Any new invention which would eliminate the troubles would be welcome. From his point of view, the chief advantage of the device described by Mr. Boardman was that there was absolutely no risk of silicosis being incurred by the operator, for dust and grit were taken completely away from him. The makers of the "Wheelabrator" machine must be commended for their enterprise, though probably they would not claim that they had yet reached finality in regard to the successful working of their device.

Life of Blades

MR. J. T. GRAY thought that the blades on the "Wheelabrator" machines had to be very carefully balanced, and that they had a comparatively short working life. He wished to know whether Mr. Boardman had tried to obtain these blades manufactured in any special abrasive-resisting alloys, such as "Widia," or whether blades faced with "Widia" had been considered. He would like to have information on the effect obtained with various sizes of shot. He understood that in the case of the "Wheelabrator," owing to the shot being thrown off by centrifugal force, the specific gravity of the shot was an important factor, but did the weight of each particle of abrasive affect the efficiency? For instance, had No. 24 shot been tried, and how did the use of very fine steel shot affect the efficiency as compared with coarser steel shot?

It would also be of interest to know whether any figures were available regarding the life of the apron or the conveyor band in any plants operating on vitreous enamelling work, and whether it had been found necessary to replace any of the laths on the conveyor belt in any plants operating in this country.

Maintenance Factors

MR. BOARDMAN replied that the working life of the blades was approximately 30 to 40 hrs. Different types of metal had been tried, and it had been found that the principal consideration was expense. Using "Widia," even if there was a facing of $\frac{1}{16}$ in., would involve a cost of about £40 per set. Sometimes the life of the blades could be prolonged to 57 hrs., but the average was as stated. A facing of nickel-chrome would give a life of approximately 60 hrs. It had been ascertained that No. 16 shot was the most satisfactory for the vitreous enamelling trade. About 90 per cent. of the users had No. 16, but No. 14 gave practically the same effect in a longer time. It took a longer time to do the work with finer abrasives. There was, naturally, a harder blow with a heavier abrasive. He had tried No. 24, and had used as fine a grade as No. 40 with various results, but the time required was longer. The only information he had with regard to the life of the apron or conveyor slats was with respect to plants which had been installed in America. Only in two or three cases had the slats been removed; the links at the end had not been affected. Only the angle sections had worn, and there were only four bolts in each to remove. So far it had not been necessary to replace slats in this country for vitreous-enamelling purposes.

Effect of Shot

MR. A. K. WILLIAMS inquired if the use of a lighter shot would have any effect on the life of the blade. It would take longer to clean the article, but would the blade last longer and thereby reduce the cost? He asked whether the blade mentioned was made of ordinary steel, and whether cast manganese steel had been tried.

MR. BOARDMAN said there was no difference in the life of the blade with any of the abrasives, unless a very heavy one, such as No. 9 grade, were used, which was unusual. Such a grade was only suitable for steel castings. With regard to medium abrasives between No. 16 and No. 24, there was no difference in the wear on the blades, which were made of a special alloy. Cast manganese steel had not been tried.

Blast Pressures

MR. H. PURSLOW pointed out that Mr. Boardman had stated that the majority of vitreous enamellers were in favour of a pressure of about 60 lbs. per sq. in. Would he state what was the approximate pressure obtained from the impact of the shot to give an equivalent of 60 lbs. per sq. in. pressure of compressed air?

MR. BOARDMAN replied that it was about the same. He would not like to indicate what the direct pressure was. He could give the figure of 7 cwts. of casting cleaned in the barrel in 10 minutes. This could not be done with any direct form of barrel pressure. There was a difference of pressure with every grade of shot used, but it was roughly between 40 and 60 lbs. per sq. in.

In reply to the CHAIRMAN, MR. BOARDMAN said it was possible to calculate the speed at which grit left the wheel, but he had not any figures with him.

Blasting Times

MR. W. E. HILLER asked if the table was geared to revolve at such a speed that the work was finished in one turn, or if it had to rotate several times in order to complete the blasting.

MR. BOARDMAN said the number of rotations depended upon the nature of the work; in some cases the table would have to rotate twice. For ordinary work a single revolution sufficed to clean the casting. The same remark applied to the conveyor. The speed could be varied according to the character of the result desired.

MR. A. CONNOLLY believed that the shot cost with the "Wheelabrator" was considerably less than with the pressure abrator. He had used some No. 24 size shot with a very good dust extractor.

MR. BOARDMAN remarked that the exhaust system should be adjusted according to the size of abrasive. The suction could be regulated to remove only the very light dust. The No. 24 size was a medium abrasive. In reply to Mr. Purslow, Mr. Boardman stated that there was 350 lbs. of abrasive passing through the nozzle per min. of an airless wheel, as contrasted with 40 to 50 lbs. in ordinary circumstances.

Cleaning Stove Plates

MR. H. BRADLEY referred to the airless shot-blasting of stove plates, which might vary in length from 2 to 3 ft. by 18 in. in width, with edges of approximately $\frac{1}{4}$ in. section. Would the apparatus do the work satisfactorily on the edges?

MR. BOARDMAN replied that two wheels would be necessary. They would be mounted on a slight incline on the top of the rotary table, putting them on the rotary table to do the edges. This would bring all faces under the action of the blast. The apparatus would deal with edges satisfactorily up to a depth of $1\frac{1}{2}$ in. for vitreous enamelling. There would, of course, be a corresponding increase in running costs, but the output was increased in the same proportion. The general arrangement was to clean the top surface of the plate and then clean the edges. It was not advisable to handle the casting too often after they had been sand-blasted. Replying to further questions by Mr. Connolly, Mr. Boardman stated that the reference to 27 to 28 cwts. per hour related to the vitreous enamelling of stove parts, with a 36 to 42 Tumblast and a 10 to 15 min. charge.

The proceedings concluded with a vote of thanks to Mr. Boardman.

DISCUSSION AT BIRMINGHAM

MR. J. H. GRAY asked if the lecturer could give the costs of running the Tumblast plants. Was there a special grade of shot suitable for the airless plant, and must the blades be evenly balanced? If so, what would happen if one blade wore quicker than another?

MR. BOARDMAN replied that the running costs of the Tumblast plant, including labour, material and maintenance, were 8s. per hr. for an hourly production of 25 to 28 cwts. of castings. The majority of enamelling plants at present used No. 16 grade shot, which was quite suitable for the airless machine. The variation in wear of the blades would not cause any trouble. Blades had worked satisfactorily for 37 hrs., although on examination one was worn more than the others.

Cost of Blades

MR. F. B. SELLARS asked if the speaker could give any comparative costs between the present rotary tables and the airless type of cleaners, also the length of time of blades and their cost.

MR. BOARDMAN said he was unable to give an answer in regard to comparative costs. The life of the blades was 30 to 40 hrs. and the cost 30s. per set, or approximately 1s. per hr.

MR. P. V. G. CHAMBERS wished to know when, in the plant working continuously, the blades would be changed and whether this would cause delays.

MR. BOARDMAN said that the blades were examined after 25 hrs.' use; one blade might have worn and this could be changed. A full set of blades could be changed in 5 min.

MR. CHAMBERS remarked that this would cost approximately £6 per week. What would be the total cost of maintenance other than blades?

MR. BOARDMAN repeated that the total cost, which included blades, all maintenance, labour and material, was 8s. per 25 to 30 cwts.

Speed and Breakages

MR. B. E. HOBLEY asked if there had been recent developments in the Tumblast plant, as his experience of one plant was that on one batch of castings 50 per cent. breakage occurred during blasting.

MR. BOARDMAN, agreeing, said that on the machine mentioned there would be a one-speed motor, whereas the present machines had variable-speed motors and the speed of the barrel could be adjusted according to the type of casting to be cleaned.

MR. W. TODD asked what would be the number of revolutions for the larger sizes of castings.

MR. BOARDMAN replied that there would be 10 to 12 revs. per min. For the smaller casting this could be increased to 25 revs. per min.

MR. BRADSHAW inquired if the speaker had any data on the consumption of chilled steel abrasive with the airless plants. His experience of the pneumatic type was a consumption of 3 to 6 lbs. of abrasive per 100 lbs. castings.

MR. BOARDMAN said the loss of abrasive on the airless type was about 18 lbs. per working hour.

MR. WRAY asked what types of castings could safely be cleaned in the airless plant.

MR. BOARDMAN said that all small castings could be cleaned in the barrel type and the large ones on the conveyor type or upon the rotary table.

MR. WRAY asked if there was any limit to the size of casting that could be cleaned.

MR. BOARDMAN replied in the negative.

The Edge Problem

MR. TODD expressed the view that it had always been difficult to clean the edges of castings satisfactorily. Even with the pressure type cleaner, castings had to be taken off the table and finished in the hand chamber. He asked if this had been overcome in the airless type.

MR. BOARDMAN said it could only be done by using two wheels, and these must be set at an angle.

MR. BACKHOUSE asked if an enamelling plant could be run completely on airless plants.

MR. BOARDMAN said that this could be done on the "Planer" type, but the castings would have to pass through the machine twice to clean edges sufficiently, as had been illustrated.

MR. BACKHOUSE asked if cast iron could be de-enamelled in the machine.

MR. BOARDMAN replied that the time required was 15 to 20 min.

MR. CHAMBERS asked what would happen if there were small switchboxes and large lavatory cisterns to be cleaned.

MR. BOARDMAN said the switchboxes would be put in the barrel and the cisterns on a rotary table, the latter being turned round so that the whole surface was covered.

MR. CHAMBERS asked whether a large number of breakages of, say, lugs would not occur on the switchboxes.

MR. BOARDMAN said that if the speed of the barrel was correct for that type of casting, no breakages would occur.

MR. GRAY said that he had seen switchboxes satisfactorily cleaned without breakages on the Tumblast plant.

Vote of Thanks

MR. TODD, expressing a vote of thanks to Mr. Boardman for his Paper, remarked that he had recently visited Germany and had seen a number of airless plants. He remarked, however, that in all cases where the rotary-table type was used the centrifugal units were angled and mounted on the side of the table, and the results obtained were particularly good. There was a large variation in the grade of shot used, and some of the work done would not pass British inspection standards. They were, however, making definite progress in the development of the airless plants. He had seen the "Planer" type both operated by air and airless, and while with all new introductions there were a number of drawbacks, these were slowly being overcome. He felt that the German plants were superior to the ones he had seen in this country, but he thought that British manufacturers were making definite progress, and the thanks of all enamellers were due to them for the developments in this direction. He asked Mr. Boardman to accept the sincere thanks of the Institute and the members present for his contribution towards the increased use of airless type shot-blast plants. MR. BOARDMAN suitably responded.

Drying of Enamel Ware

At the November meeting of the Midland Section of The Institute of Vitreous Enamellers, MR. P. G. PICKWELL read a Paper, printed in our issue of December 3, on the "Principles and Practice of Drying Enamel Ware." The discussion which followed was opened by MR. H. H. MACEY (Stoke-on-Trent), who said he had been engaged under Dr. Mellor for several years on research work on the drying of clay. The drying problems of clay, he stated, were rather different from those involved in the drying of vitreous enamel. In clay there was a very large shrinkage, which might be a half-inch per foot. Clay was naturally dried from the outside, which shrunk, the water having to reach there from the inside. A pressure of 3,000 to 4,000 lbs. per sq. in. was required to force water through 1 in. thickness of clay at the rate at which clay was dried. The problem of drying clay was, therefore, rather a matter of what occurred inside the clay than what happened outside. If a cube of clay was pressed before drying, it would shrink differently in height from the other two directions. If a bar of it were bent and straightened out again, it would bend back in the drying.

A factor common to clay and enamel was that of air velocity. Water evaporated because of its vapour pressure, which was dependent upon the temperature of the water. There was also to be considered the vapour pressure of the water already in the surrounding atmosphere. The vapour pressure in water being heated was the pressure driving the molecules of water out; vapour pressure of moisture in the air was a force tending to prevent drying. The rate at which water evaporated was, therefore, directly dependent on the difference between the vapour pressure of the water in the clay, or in the enamel, and that of the air. A very large proportion of the heat required in any drying operation was wasted in heating the air passing through the drier. The rate of loss was considered to be about 10 per cent., but the hot air temperature was rather above the normal required for drying clay. The temperature required to dry-heat the air depended upon the temperature of drying. It was difficult to give any direct estimate of the amount of heat required purely to heat the air which went through the drier. He would say it was at least 30 to 40 per cent. of the total used. The more saturated the air passing through the drier, the less air was required, for the more saturated the air was, the higher was the vapour pressure of the water vapour in that air. The smaller, therefore, would be the difference between the two vapour pressures and the lower would be the drying temperature. There a gain could be obtained by increasing the velocity of the air passing through the stove.

Effect of High Air Velocity

Quoting from "Evaporation of Water from Plane and Cylindrical Surfaces," a Paper given before the Chemical Society by Powell and Griffiths, Mr. Macey said that from experiments in passing an air stream over a vertical cylinder it was calculated that at a speed of 100 cms. per sec. the total rate of drying was 5.4; with a speed of 200 cms. per sec. it was 8.3; and with a speed of 300 cms. per sec. it was 10.6. At the same respective speeds the corresponding figures for a horizontal plane were 3.4, 5.7 and 7.8. From the latter figures it would be seen that the difference in vapour pressures could be decreased in the ratio of 3.4 to 7.8. That did not mean that the air was decreased by as large a ratio as that. The air was reduced by at least 40 per cent. In conclusion, Mr. Macey said that high air velocities in any drier were definitely possible and economic from the heat point of view.

Economy of Conveyors

MR. W. TODD remarked that in the last five years one or two firms had shown that there were great possibilities in the adoption of mechanical methods such as Mr. Pickwell had described. Too frequently, however, he found that in discussing these methods the mere mention of the word "conveyor" suggested an expenditure of many thousands of pounds and a colossal output. In fact, that was not so. The initial capital expenditure might be heavy but not excessive. The first installation of the kind at his own works was made with a great deal of trepidation, but it had not been operating long before they realised its possibilities. Normally, one could reduce a salesman's promised results by 50 per cent., but in this instance they eventually speeded up the conveyor by 100 per cent. Enamellers could not afford to spend months on research; they wanted results.

Drying Cast Iron

MR. B. E. HOBLEY asked Mr. Pickwell what temperature he advised for drying cast iron.

MR. PICKWELL replied that the temperature was really limited by the size and thickness of the casting, but the usual temperature ranged from 130 to 140 deg. Fah.

In reply to another question from MR. HOBLEY the LECTURER said the power consumption on the conveyor mentioned was very small. He believed a 1½-h.p. motor was employed though the actual requirement was only about $\frac{1}{10}$ h.p. The chief consuming units were the ovens, and the total power, including the conveyor consumption, would not exceed 6 h.p., at a cost of about 2s. per hr.

Temperature of Rust-Spotting

MR. READ remarked that, so far as he knew, the precise temperature to which cast iron had to be heated to prevent rust-spotting had never been discussed. He added that there must be a critical temperature at which the casting would begin to rust.

MR. S. HALLSWORTH suggested that cast iron would not rust at 90 deg. Fah. The essential point was the time which elapsed between the spraying and the commencement of drying.

The CHAIRMAN (Mr. Todd) commented that it would rust even then if it were allowed to stand.

MR. HALLSWORTH said that on a hot, dry day he had seen cast iron dried in the workshop without rusting.

MR. TODD said that, on the other hand, he knew of cases when the casting rust-spotted while being taken from the spraying booth to the drying chamber.

MR. J. H. PRICE mentioned that in an experiment he had left castings to dry in a current of cold air and no rust-spotting had occurred.

MR. A. B. ALLAN pointed out that with a particular type of enamel it was possible to put castings in water without any rust-spotting occurring.

Spraying and Rust-Spotting

MR. W. LAWRENCE said he believed that the amount of enamel sprayed had a definite bearing on the amount of rust-spotting which occurred. If, after drying the ground coat enamel, a casting were heavily spotted with white, then, unless precautions were taken, the dry mottle rust-spotted. The moisture from the white spotting penetrated to the casting and introduced rust-spotting. It seemed that on some conveyor driers it was practical to dry the ground coat enamel, then spot the casting and dry again to prevent rust-spotting.

The CHAIRMAN said the problem was dependent upon the finish required. When white was spotted on grey ground-coat the white failed to dry.

MR. LAWRENCE asked why too heavy spraying of white failed to prevent rust-spotting.

MR. READ replied that often the enamel became soaked, and therefore had to be dried before further operations were undertaken.

MR. J. FALLON mentioned that in the sheet industry, both in this country and in America,

(*Concluded on page* 16.)

STANTON-DALE
REFINED PIG IRON

Three typical analyses

	Total Carbon	Silicon	Sulphur	Phos.	Mang.
Motor-car cylinders	3	1·8-2·2	·05	·3	·5
Hydraulic Work	3·2	1·5-1·8	·07	·4	·5
Gas and Marine cylinders	3	1·3-1·6	·07	·5	·5

Stanton-Dale is a low total carbon pig giving close-grained, grey iron castings of great strength and toughness. Seven standard grades are available, and we can also supply to customers' own requirements without extra cost.

The Stanton Ironworks Company Limited, Near Nottingham

The Largest Producers of Foundry Pig Iron (for sale) in Great Britain

The Week's News in Brief

Trade Talk

ORDERS FOR THREE 9,000-ton vessels have been secured by James Laing & Sons, Limited, Sunderland.

CHARLES CONNELL & COMPANY, LIMITED, Scotstoun, Glasgow, have received a contract for two high-class steamers.

THE CARRON COMPANY, Falkirk, has acquired the Stirlingshire assets of the Alloa Coal Company, Limited, for £500,000.

A REDUCTION OF £20 per ton in the price of nickel came into operation on January 1. This reduces the current quotation to £180 to £185.

ASEA ELECTRIC, LIMITED, have removed their London office from Chancery Lane to Fulbourne Road, Walthamstow, E.17, where their works are situated.

THE TENDER offered by John Brown & Company, Limited, Clydebank, for a new £7,500,000 battleship has been accepted by the Admiralty, subject to the adjustment of details.

H.R.H. THE DUKE OF KENT has consented to be the principal guest at the banquet to mark the opening of the British Industries Fair, to be given by the Government at the Mansion House on February 15.

THE BRITISH main-line railway companies' combined programmes for 1937 provide for 512 new locomotives, 2,000 new carriages, 32,460 new goods wagons of various types, 950 more containers, and 500 container-carrying wagons.

THOMAS E. GRAY & COMPANY, LIMITED, of London, have received a contract from the Admiralty for the modernisation of the core and mould drying stoves at H.M. Dockyard, Chatham. This contract follows other installations of the British Herrmann system at Portsmouth and Devonport dockyards.

Drying of Enamel Ware

(*Concluded from page* 14.)

it was found that if the temperature lagged during drying, stains were indelibly fixed on the sheets. If the temperature rose evenly the sheets were free from stain. The temperature lag caused re-condensation, resulting in a stain.

MR. LAWRENCE asked if Mr. Pickwell had attempted to dry sheet iron, ground coat, in an oil-operated conveyor furnace with the enamel in contact with the products of combustion.

MR. PICKWELL answered that he had not, though he had often wished to. He had been told that the presence of sulphur in the circulating air had an effect upon the fusing. He did not know why.

The Sulphur Question

MR. LAWRENCE said that in experiments he had made in this connection the products of combustion had had no effect whatsoever upon the enamel. Regarding the effect of the products of combustion from oil, Mr. Lawrence said he had seen such a drying process produce satisfactory and unsatisfactory results. In some cases there was a tendency to fish-scale, but this could not be attributed to any definite cause. A white ground-coat previously dried was satisfactory.

The CHAIRMAN considered that a similar effect would be obtained from an oil-fired drier as with an oil-fired muffle which was sulphur producing.

MR. READ said that for many years his firm had dried with a system of waste gas from the furnaces and an oil fire. Cracks through which the products of combustion penetrated were numerous.

MR. HALLSWORTH observed that sulphur could be introduced into muffle without causing sulphuring. A bowl of water should be introduced with it. When flowers of sulphur were put in, the work came out satisfactorily, but with sulphurous acid in contact with the dried biscuit sulphuring was evidence after fusing.

A vote of thanks to the lecturer and chairman was proposed by MR. J. FALLON, and heartily accorded.

ABOUT 260 GUESTS were present at a party for children of the employees of Qualcast, Limited, Derby, held on New Year's Day. The chairman and managing director, Mr. V. Jobson, Mr. C. W. Bigg, the assistant managing director, and Mr. E. C. Marsland, works manager, were amongst those present.

MR. T. B. CORBETT, managing director of John Williams & Company (Wishaw), 1922, Limited, Excelsior Iron and Steel Works, Wishaw, speaking at the annual social and dance of the staff, referred to the installation of new and additional machinery, and an extension which is to be made to the foundry.

MR. HUGH MURDOCH, general secretary of the Central Iron Moulders' Association, states that out of a total membership of about 9,500, 359 members were unemployed at the beginning of 1936 and 175 at the end of December. The supply of skilled and experienced men was insufficient to meet the demand in the rain water, soil goods and general hollow-ware departments.

AT THE ANNUAL WORKS DINNER of Hale & Hale (Tipton), Limited, recently, the chairman of the company (Mr. W. E. Hale) announced that he and his brother had decided to devote three-fifths of their income from the ordinary shares of the company to the service of all those in the company's employ. Out of every £5 they received in interest, £2 would go to the people in the works and £1 to members of the staff.

THE SOUTHERN RAILWAY COMPANY have placed orders for the supply of about 18,000 tons of cast-iron railway chairs with North-East Coast firms. The allocations are as follow:—Pease & Partners, Limited, Middlesbrough, 7,400 tons; Tees-side Bridge & Engineering Company, Limited, Middlesbrough, 3,500 tons; Head, Wrightson & Company, Limited, Thornaby, 2,650 tons; Smith, Patterson & Company, Limited, Blaydon-on-Tyne, 4,500 tons.

IRON AND STEEL WORKS in North Lincolnshire are embarking upon several schemes of development and improvement. The Appleby-Frodingham steelworks are to erect coking plant with by-product recovery works, and a site is now being cleared for the purpose. In other directions also the Appleby-Frodingham works are to be extended. The sintering plant is to be extended. Another coking development in the Lincolnshire area is the decision of John Lysaght, Limited, to add 23 ovens to the existing battery. A start has been made on the building of a light railway from the works to the proposed new wharf on the Trent.

Company Reports

F. H. Lloyd & Company, Limited.—Interim dividend at the rate of 3 per cent. on the ordinary shares in respect of the half-year ending December 31, 1936.

Follsain Syndicate, Limited.—Report for 1936 states that directors have actively pursued main objects:—(1) Cumulative proof of the commercial value of Follsain processes and metals; and (2) realisation of resulting goodwill by sale of patents abroad. To complete proof it was necessary to enable Follsain Metals, Limited, to produce on a commercial scale; to deal with foreign rights the Syndicate had to acquire patents in 23 industrial countries. The Syndicate underwrote and issued 250,000 6 per cent. cumulative preference shares of 10s. each in Follsain Metals, and proceeds have enabled Follsain Metals to reconstruct and extend plant. Syndicate holds just over 50 per cent. of issued shares of Wycliffe Foundry Company, Limited. It is intended to acquire remaining shares and to arrange amalgamation of Wycliffe Foundry and Follsain Metals assets. The balance-sheet shows development expenditure for period from April 18, 1932, at £35,830.

Obituary

MR. FRANCIS MATTISON, principal of F. Mattison & Company, ironfounders, of Leeming Bar, Northallerton, has died at the age of 88.

Personal

MR. J. WALKER, erecting shop foreman with the North British Locomotive Company, Limited, Springburn, Glasgow, has retired after 36 years' service.

MR. AND MRS. ANDREW HILL, of Stenhousemuir, have celebrated their golden wedding. Mr. Hill had worked as a moulder with the Carron Company, Falkirk, for 41 years, retiring six years ago.

MR. DAVID K. TULLIS, founder of D. & J. Tullis, Limited, Clydebank, was presented at the annual dinner of the foremen and staff with a silver salver on which were engraved the names of 32 of the oldest employees. Mr. Tullis founded the firm 46 years ago.

MR. HARRY MCGREGOR, a member of the staff of John G. Stein & Company, Limited, Castlecary Works, Bonnybridge, has received a bookcase bureau from the staff, on the occasion of his marriage. The presentation was made by the chairman, Capt. Alan Stein.

MR. FRANK G. STEINEBACH has been appointed editor of "The Foundry," succeeding Mr. Dan M. Avey, who, as previously announced, is now secretary-treasurer of the American Foundrymen's Association. Mr. Steinebach is a graduate of Purdue University, holding a bachelor of science degree in electrical engineering. He has been connected with technical journalism since 1922. We wish Mr. Steinebach every success in his new position.

MR. J. C. GOODENOUGH, who for the past two and a-half years has been assistant to the managing director (Mr. Lawrence Ennis, of Dorman, Long & Company, Limited), has been appointed general manager. Mr. Frank Shepherd, general works manager of the company's Britannia Steelworks, Middlesbrough, has been appointed general works manager for all coke-ovens, iron and steel works and rolling mills. After 27 years' work with the firm Mr. A. E. Alcock has retired from the post of general works manager of the Cleveland Works; his successor is Mr. L. B. Cooper, his former assistant. Mr. Robert Gray, general works manager of the Redcar Works, has also retired after 35 years' service, and will be succeeded by Mr. H. Featonby, his assistant. Mr. E. T. Judge, of Middlesbrough, has been appointed chief technical engineer, and Mr. C. Moody, of Middlesbrough, has been appointed chief works engineer.

Wills

TARRANT, H. W. R., manager of the Whitecross Company, Limited, wire manufacturers, Warrington £1,234

WISEMAN, F. B., a director of Christy & Norris, Limited, engineers and ironfounders, of Chelmsford £16,376

Forthcoming Events

JANUARY 11.

Iron and Steel Institute:—Joint Meeting with the Cleveland Institution of Engineers. "Constitution of Blast-Furnace Slags in relation to the Manufacture of Pig-Iron," Paper by T. P. Colclough, at the Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough, at 7.30 p.m.

JANUARY 19.

Iron and Steel Institute:—Joint Meeting with the Staffordshire Iron and Steel Institute. "Controlled Grain Size in Steel," Paper by T. Swinden and G. R. Bolsover, at the Imperial Hotel, Birmingham, at 7 p.m.

Institute of British Foundrymen

JANUARY 9.

Burnley Section:—Annual Social, Nelson House, Burnley, at 5 p.m.

Scottish Branch:—"Mechanisation in the Foundry," Paper by N. C. Blythe, at the Royal Technical College, Glasgow, at 4 p.m.

JANUARY 12.

Burnley Section:—"Science and its Use to the Practical Foundryman," Paper by J. Hill, at the Municipal College, Ormerod Road, Burnley, at 7.15 p.m.

JANUARY 15.

Middlesbrough Branch:—"Making a Diesel Engine Cylinder Liner," Paper by J. C. Charlton, at the Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough, at 7.45 p.m.

JANUARY 16.

Falkirk Section:—"Porosity in Castings," Paper by Prof. R. Hay, at the Temperance Café, Lint Riggs, Falkirk, at 6 p.m.

West Riding of Yorkshire Branch:—Annual Dinner and Dance, at 6.30 p.m.

The Institute of Vitreous Enamellers

JANUARY 15.

Southern Section:—Debate on Degreasing, at Imperial Chemical House, Millbank, London, S.W.1, at 8 p.m.

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FREE SAMPLES & DEMONSTRATION

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WARNER Special PIG IRONS

- Warner C.B.R.
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- Low Carbon Cylinder
(FOR CYLINDERS, ROLLS, ENGINEERING CASTINGS, ETC.)
- Low Carbon Malleable
(FOR MALLEABLE CASTINGS OF ALL DESCRIPTIONS)

Supplied to any specification between limits of 2·00 and 3·50% Carbon and ·50% and 3·50% Silicon

ACTUAL ANALYSIS CERTIFICATES ARE AVAILABLE WITH EACH DELIVERY

Typical Cylinder Pig Iron Specification

TOTAL CARBON	2·70%
SILICON	1·80%
MANGANESE	·90%
SULPHUR	·06%
PHOSPHORUS	·40%

Typical Malleable Pig Iron Specification

TOTAL CARBON	2·60%
SILICON	·75%
MANGANESE	·50%
SULPHUR	·05%
PHOSPHORUS	·06%

WARNER & CO. LTD.
MIDDLESBROUGH

Raw Material Markets

Owing to the uncertainty which has prevailed with regard to the prices of iron and steel products during the last month or so, business has been restricted. Now that quotations have been revised this limiting factor no longer remains. The demand continues to be insistent, but the shortage of supplies prohibits the transaction of any substantial amount of new business. Only a considerable expansion of outputs can relieve the pressure for deliveries, which, in some cases, are much behind schedule.

Pig-Iron

MIDDLESBROUGH.—It is as well for both producers and consumers in this area that an expansion of output is to take place in the near future. Any additional material will be eagerly taken up, and it is doubtful whether there will be any pronounced improvement in the prevailing conditions. It is a case of "every little helps," however, and consumers can rest assured that they are receiving the maximum possible supplies. Much of the material being delivered at the present time is on account of contracts entered into before the recent price advance. Imported pig-iron is still in heavy volume, and will soon be in excess of exports. No. 3 Cleveland G.M.B. is quoted at 81s. per ton in the Middlesbrough area, 83s. elsewhere on the North-East Coast, 84s. in Falkirk, and 87s. in Glasgow. There has been no relaxation of the efforts to obtain new contracts, in spite of the higher quotations now demanded.

New prices are also quoted for hematite, and makers are prepared to accept further orders for delivery over the first half of the year where supplies are forthcoming. It is generally agreed that the advance in prices of 12s. 6d. per ton is reasonable, and that the increasing of the differential rates charged for hematite with a low sulphur and phosphorus content was the factor that prevented a much higher quotation. Mixed numbers of East Coast hematite are now charged at 97s. 6d. in the Middlesbrough district, subject to a rebate of 5s. per ton.

LANCASHIRE.—Most consumers of pig-iron have continued to call for heavy deliveries against existing contracts. There has not been a great deal of new business recently, but this must follow when contract commitments have been met. For delivery in the Lancashire zone, offers of Staffordshire and Derbyshire brands No. 3 foundry iron are quoted on the basis of 89s. per ton, with Northamptonshire at 87s. 6d. and Derbyshire forge iron at from 84s. to 86s. according to the class of user. There is a steady inquiry for hematite at the recently advanced prices. West Coast material is quoted on the basis of 106s., subject to a rebate of 5s. per ton, for delivery in the Manchester area, with East Coast at 105s. 6d. Scottish foundry is offered at about 105s. for delivery equal to Manchester.

MIDLANDS.—Stocks of Northamptonshire iron are negligible and many users are compelled to use Derbyshire material as a substitute. Northamptonshire foundry No. 3 is quoted at 83s. 6d. per ton, with Derbyshire and Lincolnshire No. 3 at 86s., delivered Birmingham and Black Country stations. Forge pig-iron at 5s. per ton below the price of No. 3 foundry iron is well inquired for, but here, again, Northamptonshire supplies are scarce. An active market is experienced for special irons, chiefly from the motor and heavy engineering establishments. Prices are without control and vary considerably according to the quality and the transport costs incurred. Medium-phosphorus iron is quoted from 90s. to 95s., low-phosphorus from 97s. 6d. to 107s. 6d. and refined iron from £6 5s. to £7 15s. per ton, delivered the Midlands. The price of Scottish iron is now around 107s. 6d., but new business at this level is impossible. An insistent demand continues to be received for hematite, but supplies are scarce, and considerable inconvenience is experienced by many users. For delivery to Birmingham and Black Country stations, West Coast mixed numbers are quoted at £5 9s. 6d., East Coast No. 3 at £5 8s. 6d. and Welsh mixed numbers at £5 8s. An extra 1s. 6d. per ton is charged if delivery into works is stipulated.

SCOTLAND.—Owing to the active state of trade in this area, the New Year holidays were made as short as possible. New contracts are limited by the lack of supplies. No. 3 foundry iron is still quoted at 88s. f.o.t. furnaces, with 2s. 6d. extra for No. 1. Prospects with the light-castings makers are excellent. There is no change in the price of No. 3 Cleveland, which is 84s. f.o.t. Falkirk and 87s. f.o.t. Glasgow, with No. 3 Northamptonshire at 1s. 3d. per ton less. Hematite mixed numbers are 98s., less 5s. rebate, delivered f.o.t. steelworks

Coke

Prices on the foundry-coke market remain unchanged, but advances are expected to be made in the near future. Little effect will, however, be felt for a considerable time, as most consumers have long since entered into contracts for their winter requirements. For delivery in Birmingham and district, best Durham coke is quoted at from 42s. 6d. to 43s. and Welsh from 39s. 6d. to 54s. per ton, according to analysis.

Steel

Although the Christmas and New Year holidays were curtailed in the producing districts, business in the steel market was not fully resumed until this week, states the official report of the London Iron and Steel Exchange. The British steel industry is entering the New Year under difficult conditions, as, in spite of the record production of steel, there seems little hope of overtaking the demand for some months to come. The steel trade requirements of hematite are on a heavy scale, and the recent advance in prices has not affected the demand. In the semi-finished steel department, consumers are finding it difficult to secure all the material they need, and some anxiety is felt regarding the adequacy of future supplies. Many of the home producing works have retired from the market for the time being, owing to the congested state of their order-books. Great activity developed in the finished steel market directly the holidays were over, and business was only limited by the ability of manufacturers to accept orders for the required deliveries. Most works are in arrears against contracts, although the mills are operating at capacity. Export business has been on a comparatively small scale, owing to the enormous pressure of the home demand.

Scrap

The customary seasonal holidays were sacrificed this year in the Cleveland area and full activity has been maintained. Difficulty is experienced in obtaining some grades of scrap and prices are likely to advance further. It is believed that 62s. 6d. is about the average current quotation for heavy steel scrap. Machinery metal in small parcels only is at 70s., while heavy foundry cast iron at 67s. 6d. is also only sold at this figure in small tonnages. The Midland market is firm all round. Prices, however, are considered to be high and this is restricting new business. Heavy steel in furnace sizes is at 55s., with mixed heavy iron and steel at a similar figure. Heavy unsheared wrought iron is at 67s. 6d. There is an active inquiry for heavy machinery metal in cupola sizes at 72s. 6d., good heavy is at 70s., and clean light at 55s. Short, heavy steel, suitable for use in the foundries, is at 70s. per ton, delivered works. Satisfactory conditions prevail on the Yorkshire market, which is steady. There is no anxiety on the part of suppliers to obtain new orders and they are frequently only willing to accept contracts for small tonnages for early delivery. Heavy basic steel for melting is at a minimum of 62s. 6d. delivered. Foundry cast iron is active at 70s. and heavy wrought shearing iron at 68s. 6d. Steelworks heavy cast-iron scrap is quoted up to 57s. Heavy deliveries of scrap material have been made in Scotland recently and the market is in an active condition. Heavy mild-steel scrap in furnace sizes is at 57s. 6d., while 52s. 6d. is paid for heavy basic or heavy iron and steel scrap mixed. Heavy machinery cast-iron scrap is at 73s. 6d. to 75s., for pieces not exceeding 1 cwt., while ordinary cast iron, to the same specification, is at 68s. 6d. per ton, delivered f.o.t. consumers' works.

Metals

The London Metal Exchange was closed on New Year's Day.

Copper.—A seasonal quietness overtook this market at the New Year, and little business has since been transacted. Holidays and stocktaking usually interrupt activities at the consuming plants at this time of the year. Upon the resumption of normal trade, however, consumption is likely to return to its pre-Christmas level, and the outlook generally is quite satisfactory. The domestic price of copper in the United States has further advanced and is now at 12 cents per lb.

Daily market prices :—

Cash.—Thursday, £49 7s. 6d. to £49 8s. 9d.; Monday, £49 10s. to £49 12s. 6d.; Tuesday, £48 7s. 6d. to £48 10s.; Wednesday, £48 17s. 6d. to £48 18s. 9d.

Three Months.—Thursday, £49 13s. 9d. to £49 15s.; Monday, £49 15s. to £49 17s. 6d.; Tuesday, £48 13s. 9d. to £48 15s.; Wednesday, £49 2s. 6d. to £49 5s.

Tin.—As has been the case in other non-ferrous metal markets, dull conditions have prevailed since Christmas, and new business has been scarce. On the Continent, also, trade has been quiet, but in the United States there has been a fair amount of activity. One of the most satisfactory features of the American tin market during 1936 was the continued strength of the tinplate industry, which was well maintained right up to the end of the year. The output of tinplates for the year was well in excess of the highest level previously recorded. The statistics for the month of December compiled by Mr. W. H. Gartsen (Henry Rogers, Sons & Company) reveal that the total visible supply at the end of that month was 19,722 tons, compared with [illegible] tons at the end of November. The carry-over in the Straits Settlements was 2,122 tons, against 2,939, while the carry-over at the Arnhem (Holland) smelter was 851 tons, against 934 tons. Total visible supplies at the end of 1936 at 19,722 tons compare with 12,305 tons at the end of 1935 and 12,633 tons at the end of 1934. The International Tin Cartel met in Brussels on Tuesday, and a new agreement for the continuation of the Cartel until the end of 1941 was signed at the meeting. The quota for the first quarter of 1937 is fixed at 100 per cent. of the new standard capacity. The next meeting will be held in Paris on March 5.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £233 to £233 5s.; Monday, £231 to £231 5s.; Tuesday, £228 7s. 6d. to £228 12s. 6d.; Wednesday, £228 15s. to £229 5s.

Three Months.—Thursday, £233 10s. to £233 15s.; Monday, £231 10s. to £231 15s.; Tuesday, £229 to £229 5s.; Wednesday, £229 15s. to £230 5s.

Spelter.—Although consumption has increased, quotations remain high. Prospects for a continuance of heavy trade buying as soon as the seasonal quietude has left the market are good.

Official quotations were as follow :—

Ordinary.—Thursday, £19 18s. 9d.; Monday, £19 18s. 9d.; Tuesday, £19 1s. 3d.; Wednesday, £18 8s. 9d.

Lead.—While consumption is reported to be satisfactorily maintained, new buying is not active. Much speculative interest has been displayed in recent weeks, and this has caused considerable price fluctuations. On the other hand, the United States market has shown great activity, and many consumers have been quite unable to obtain their full requirements, even after offering to pay premiums.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £28 7s. 6d.; Monday, £27 2s. 6d.; Tuesday, £26 12s. 6d.; Wednesday, £26 11s. 3d.

Contracts Open

Bideford, January 21.—Iron castings, wrought-iron and steel, for the Town Council. The Borough Surveyor, Town Hall.

Llancloudy, January 18.—2¼ miles of 2-in. dia. galvanised iron water mains, for Ross and Whitchurch Rural District Council. Mr. W. H. Bateman, Batheaston, Bath. (Fee £2 2s., returnable.)

Southport, January 18.—Iron castings, smithy iron, etc., bolts and nuts, galvanised goods, screws, nails, lead piping, for the Town Council. Mr. A. E. Jackson, borough engineer, Town Hall.

Wellington, January 12.—1-ton hand-operated overhead travelling crane, single-girder type, to run on 20-lb. rail with 1⅜-in. head, and capable of lifting a working load of one ton (2,240 lbs.), for the New Zealand Public Works Department. The Department of Overseas Trade. (Reference T. 2,223.)

For **"easy stripping"** use

YORKSHIRE SAND

Yorkshire Sand is of a synthetic nature, its production being under careful laboratory control. Perfect standardization is obtained with the various grades, suitable for light and the heaviest steel castings.

It is because of the refractoriness of the sand and of the toughness of the mould surface that castings made with Yorkshire Sand are distinguishable by their excellent finish.

Please address all enquiries to the nearest Sales Office :

GENERAL REFRACTORIES LTD.,

Genefax House, Sheffield

Telephone : *Sheffield 31113 (6 lines).*

Telegrams : *"Genefax, Sheffield."*

LONDON OFFICE:	SCOTTISH OFFICE:	SOUTH WALES OFFICE:	MANCHESTER OFFICE:
Russell House, Adelphi, W.C.2.	156, St. Vincent St., Glasgow.	11, Wind St., Swansea.	9, Albert Square, Manchester, 2.
Telephone: Temple Bar 7361.	Telephone: 5250.	Telephone: 3680.	Telephone: Blackfriars 6130.
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★

Read what an IMPORTANT STEELFOUNDER says :—

"During the 40 years I have been connected with Steel Foundry work, considerable changes have taken place. Away back, we had Steel Moulders' Composition, Old Crucible Pots, etc., and each works claimed to have its own 'secret' moulding composition. High Silica Sand has eliminated practically all these from many foundries and to-day we have your 'Yorkshire Sand' which acts almost like a chill, and leaves the skin of the casting blue-black and as clean as cast iron.

The hot steel lies quietly against the wall of sand, and often when the casting has been lifted out of the mould, the latter looks as if it could be used over again, just like a permanent mould."

RAW MATERIALS—PRICE LIST

(Wednesday, January 6, 1937)

COPPER

	£	s.	d.
Standard cash	48	17	6
Three months	49	2	6
Electrolytic	53	15	0
Tough	52	5	0
Best selected	52	15	0
Sheets	81	0	0
India	62	5	0
Wire bars	54	0	0
Ingot bars	54	0	0
H.C. wire rods	57	10	0
Off. av. cash, Dec.	45	19	8 4/11
Do., 3 mths., Dec.	46	5	10 10/11
Do., Sttlmnt., Dec.	45	19	6 8/11
Do., Electro, Dec.	50	13	9
Do., B.S., Dec.	50	13	0
Do., wire bars, Dec.	51	0	2 8/11
Solid drawn tubes			12½d.
Brazed tubes			12½d.
Wire			7¼d.

BRASS

Solid drawn tubes	11d.
Brazed tubes	13d.
Rods, drawn	9¾d.
Rods, extd. or rlld.	5¾d.
Sheets to 10 w.g.	9¼d.
Wire	9d.
Rolled metal	8¾d.
Yellow metal rods	5¾d.

TIN

	£	s.	d.
Standard cash	228	15	0
Three months	229	15	0
English	229	0	0
Bars	231	17	6
Straits	231	5	0
Australian	228	15	0
Eastern	233	0	0
Banca	230	15	0
Off. av. cash, Dec.	232	5	1 4/11
Do., 3 mths., Dec.	232	4	9 11/16
Do., Sttlmt., Dec.	232	5	8 8/11

SPELTER

	£	s.	d.
Ordinary	18	8	9
Remelted	16	5	0
Hard	18	0	0
Electro 99.9	20	10	0
English	19	5	0
India	17	0	0
Zinc dust	22	15	0
Zinc ashes	5	7	6
Off. aver., Dec.	18	1	0 3/11
Aver. spot, Dec.	17	19	11 7/16

LEAD

	£	s.	d.
Soft foreign ppt.	26	11	3
Empire	27	7	6
English	28	15	0
Off. aver., Dec.	25	10	7½
Aver. spot, Dec.	25	11	2 7/16

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb

ZINC SHEETS, &c.

	£	s.	d.		£	s.	d.
Zinc sheets, English	30	10	0	to 31	0	0	
Do., V.M. ex-whse.	30	10	0	to 31	0	0	
Rods				32	0	0	

ANTIMONY

	£	s.	d.		£	s.	d.
English	72	0	0	to 73	0	0	
Chinese, ex-whse.				58	0	0	
Crude, c.i.f.				30	0	0	

QUICKSILVER

	£	s.	d.
Quicksilver	14	2	6

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—							
25%				8	17	6	
40/50%	11	0	0	to 12	5	0	
75%	16	2	6	to 17	7	6	
Ferro-vanadium—							
35/50%				12/8 lb. Va			
Ferro-molybdenum—							
70/75% carbon-free				4/6 lb. Mo.			
Ferro-titanium—							
20/25% carbon-free				9d. lb.			
Ferro-phosphorus, 20/25%				£21 to £22			
Ferro-tungsten—							
80/85%				3/1½ lb.			
Tungsten metal powder—							
98/99%				3/3 lb.			
Ferro-chrome—							
2/4% car.				33	0	0	
4/6% car.				21	10	0	
6/8% car.				21	0	0	
8/10% car.				21	0	0	
Ferro-chrome—							
Max. 2% car.				33	10	0	
Max. 1% car.				36	5	0	
Max. 0.5% car.				37	5	0	
70% carbon-free				9½d. lb.			
Nickel—99.5/100%				£180 to £185			
"F" nickel shot				£165	0	0	
Ferro-cobalt, 98/99%				7/3 lb.			
Metallic chromium—							
96/98%				2/5 lb.			
Ferro-manganese—							
76/80% loose	£11	15	0	to 12	5	0	
76/80% packed	£12	15	0	to 13	5	0	
76/80% export				£10	15	0	
Metallic manganese—							
94/96% carbon-free				1/3 lb.			

Per ton unless otherwise stated, basis 2-ton lots.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel					3	5	0
Mixed iron and steel	3	0	0	to 3	3	0	
Heavy cast iron					3	0	0
Good machinery	3	2	0	to 3	5	0	
Cleveland—							
Heavy steel					3	2	6
Steel turnings					2	5	0
Heavy cast iron	3	7	6	to 3	10	0	
Heavy machinery	3	10	0	to 3	12	6	
Midlands—							
Light cast-iron scrap					2	15	0
Heavy wrought iron					3	7	6
Steel turnings					2	0	0
Scotland—							
Heavy steel					2	17	6
Ordinary cast iron					3	8	6
Engineers' turnings					2	2	6
Cast-iron borings					1	17	6
Wrot-iron piling					3	12	6
Heavy machinery	3	13	6	to 3	15	0	

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	41	0	0
Brass	24	0	0
Lead (less usual draft)	24	10	0
Tea lead	20	0	0
Zinc	11	0	0
New aluminium cuttings	74	0	0
Braziery copper	38	0	0
Gunmetal	37	0	0
Hollow pewter	170	0	0
Shaped black pewter	124	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—

Foundry No. 1	83/6
,, No. 3	81/-
,, No. 4	80/-
Forge No. 4	80/-
Hematite No. 1	98/-*
Hematite M/Nos.	97/6*

N.W. Coast—

Hem. M/Nos. d/d Glas.	98/-*
,, d/d Birm.	109/6*
Malleable iron d/d Birm.	—

Midlands (d/d Birmingham dist.)—

Staffs No. 4 forge	83/-
,, No. 3 fdry.	86/-
Northants forge	80/6
,, fdry. No. 3	83/6
,, fdry. No. 1	86/6
Derbyshire forge	83/-
,, fdry. No. 3	86/-
,, fdry. No. 1	89/-

Scotland—

Foundry, No. 1, f.o.t.	90/6
,, No. 3, f.o.t.	88/-
Cleveland No. 3, Glasgow	87/-
,, ,, Falkirk	84/-
Scottish hem. M/Nos. d/d	98/-*

Sheffield (d/d district)—

Derby forge	80/6
,, fdry. No. 3	83/6
Lincs forge	80/6
,, fdry. No. 3	83/6
W.C. hematite	103/6*

Lancashire (d/d eq. Man.)—

Derby fdry. No. 3	89/-
Staffs fdry. No. 3	89/-
Northants fdry. No. 3	87/6
Cleveland fdry. No. 3	89/-
Glengarnock, No. 3	105/-
Clyde, No. 3	105/-
Monkland, No. 3	105/-
Summerlee, No. 3	105/-
Eglinton, No. 3	105/-
Gartsherrie, No. 3	105/-
Shotts, No. 3	105/-

* Subject to a rebate of 5s. per ton under certain conditions.

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)					10	10	0
Nut and bolt iron	8	17	6	to 9	7	6	
Hoops				11	7	6 and up.	
Marked bars (Staffs) f.o.t.					13	0	0
Gas strip				11	7	6 and up.	
Bolts and nuts, ¾ in. × 4 in.					16	0	0 and up.
Steel—							
Plates, ship, etc.	9	10	6	to 9	13	0	
Boiler plts	10	0	6	to 10	3	0	
Chequer plts.					11	3	0
Angles					9	3	0
Tees					10	3	0
Joists					9	3	0
Rounds and squares, 3 in. to 5½ in.					10	3	0
Rounds under 3 in. to ¾ in. (Untested)					9	10	0
Flats—8 in. wide and over					9	8	0
,, under 8 in. and over 5 in.					9	13	0
Rails, heavy	8	5	0	to 8	10	0	
Fishplates					12	10	0
Hoops (Staffs)					10	5	0
Black sheets, 24g. (4-t. lots)					12	0	0
Galv. cor. shts. (,,)					14	0	0
Galv. flat shts. (,,)					14	10	0
Galv. fencing wire, 8g. plain					15	10	0
Billets, soft					6	5	0
Sheet bars	6	2	6	to 6	10	0	
Tin bars	6	2	6	to 6	10	0	

PHOSPHOR BRONZE

	Per lb. basis
Strip	11½d.
Sheet to 10 w.g.	12¾d.
Wire	13¾d.
Rods	13d.
Tubes	15d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	22.31
No. 2 foundry, Valley	20.50
No. 2 foundry, Birm.	16.88
Basic, Valley	20.00
Malleable, Valley	20.50
Grey forge, Valley	20.00
Ferro-mang. 80%, seaboard	75.00
O.-h. rails, h'y, at mill	39.00
Billets	32.00
Sheet bars	32.00
Wire rods	43.00
	Cents.
Iron bars, Chicago	1.80
Steel bars	2.05
Tank plates	1.90
Beams, etc.	1.90
Skelp, grooved steel	1.80
Steel hoops	1.95
Sheets, black, No. 24	2.80
Sheets, galv., No. 24	3.40
Wire nails	2.25
Plain wire	2.60
Barbed wire, galv.	2.70
Tinplates, 100-lb box	$5.25

COKE (at ovens)

Welsh foundry	30/- to 32/6
,, furnace	24/6 to 25/-
Durham foundry	24/3 to 25/-
,, furnace	21/3 to 22/-
Scotland, foundry	28/-
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	19/9 to 20/3
,,	28×20 ,,	39/6 to 40/-
,,	20×10 ,,	28/- to 28/3
,,	18¾×14 ,,	20/6 to 21/-
C.W.	20×14 ,,	17/- to 17/3
,,	28×20 ,,	35/6 to 35/9
,,	20×10 ,,	23/9 to 24/-
,,	18¾×14 ,,	17/3 to 17/6

SWEDISH CHARCOAL IRON & STEEL

	£	s.	d.		£	s.	d.
Pig-iron	£7	0	0	to £8	0	0	
Bars-hammered, basis	£16	0	0	to £16	10	0	
Bars and nail-rods, rolled, basis	£15	15	0	to £16	0	0	
Blooms	£10	0	0	to £12	0	0	
Keg steel	£26	0	0	to £29	0	0	
Faggot steel	£18	0	0	to £23	0	0	
Bars and rods dead soft, st'l	£11	0	0	to £12	0	0	

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

			£	s.	d.		
Dec.	31	..	49	7	6	inc.	17/6
Jan.	4	..	49	10	0	,,	2/6
,,	5	..	48	7	6	dec.	22/6
,,	6	..	48	17	6	inc.	10/-

Standard Tin (cash)

			£	s.	d.		
Dec.	31	..	233	0	0	No change	
Jan.	4	..	231	0	0	dec.	40/-
,,	5	..	228	7	6	,,	52/6
,,	6	..	228	15	0	inc.	7/6

Spelter (ordinary)

			£	s.	d.		
Dec.	31	..	19	18	9	No change	
Jan.	4	..	19	18	9	,,	,,
,,	5	..	19	1	3	dec.	17/6
,,	6	..	18	8	9	,,	12/6

Lead (soft foreign, prompt)

			£	s.	d.		
Dec.	31	..	28	7	6	inc.	8/9
Jan.	4	..	27	2	6	dec.	25/-
,,	5	..	26	12	6	,,	10/-
,,	6	..	26	11	3	,,	1/3

Electrolytic Copper

			£	s.	d.		
Dec.	31	..	54	0	0	inc.	20/-
Jan.	4	..	54	10	0	,,	10/-
,,	5	..	53	10	0	dec.	20/-
,,	6	..	53	15	0	inc.	5/-

Tin (English ingots)

			£	s.	d.		
Dec.	31	..	233	0	0	dec.	5/-
Jan.	4	..	231	5	0	,,	35/-
,,	5	..	228	10	0	,,	55/-
,,	6	..	229	0	0	inc.	10/-

Spelter (Electro, 99.9 per cent.)

			£	s.	d.		
Dec.	31	..	21	17	6	inc.	1/3
Jan.	4	..	22	0	0	,,	2/6
,,	5	..	21	2	6	dec.	17/6
,,	6	..	20	10	0	,,	12/6

Lead (English)

			£	s.	d.		
Dec.	31	..	30	5	0	inc.	5/-
Jan.	4	..	29	5	0	dec.	20/-
,,	5	..	28	15	0	,,	10/-
,,	6	..	28	15	0	No change	

AVERAGE MONTHLY PRICES OF UNMARKED BARS (SOUTH STAFFS)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1901	8 0 0	7 10 0	7 5 0	7 0 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 15 0	6 17 11
1902	7 0 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 0	6 10 0	6 13 4
1903	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 7 0	6 5 0	6 9 4½
1904	6 5 0	6 5 0	6 5 0	6 5 0	6 10 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 2 11½
1905	6 5 0	6 5 0	6 0 0	5 17 6	5 15 0	5 15 0	5 15 0	5 15 0	6 0 0	6 5 0	6 15 0	6 15 0	6 1 10
1906	7 0 0	7 5 0	7 5 0	7 5 0	6 17 6	6 15 0	6 12 6	6 10 0	6 10 0	6 12 6	6 16 3	7 3 9	6 17 8
1907	7 3 9	7 5 0	7 5 0	7 5 0	7 5 0	7 7 6	7 5 0	7 7 6	7 7 6	7 7 6	7 7 6	7 5 0	7 5 11
1908	7 2 6	7 0 0	7 0 0	7 0 0	6 15 0	6 7 6	6 5 0	6 2 6	6 2 6	6 2 6	6 2 6	6 0 0	6 10 0½
1909	6 0 0	6 0 0	6 0 0	5 17 6	6 0 0	6 0 0	6 0 0	5 17 6	6 0 0	6 2 6	6 2 6	5 17 6	5 19 9
1910	6 2 6	6 3 4½	6 7 6	6 7 6	6 7 6	6 7 6	6 6 6	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 7
1911	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 10 0	6 12 6	6 16 6	6 7 0
1912	6 18 9	7 1 10	7 2 6	7 8 9	7 18 0	8 0 7	8 2 6	8 3 6	8 5 0	8 6 3	8 7 6	8 8 9	7 17 0
1913	8 11 6	8 10 7½	8 10 0	8 8 1½	8 2 0	8 0 0	7 17 6	7 11 6	7 8 9	7 5 6	6 18 1½	6 17 6	7 16 9
1914	6 17 6	6 15 7½	6 12 6	6 10 0	6 10 0	6 10 0	6 10 0	7 11 10½	8 0 0	7 12 6	7 5 7½	7 0 3	7 1 0
1915	7 11 6	8 5 11	8 8 9	9 6 0	10 3 2	10 19 2	11 12 6	11 13 1½	11 13 9	11 14 3	12 1 10½	13 0 9	10 6 0½
1916	13 7 6	13 10 8	13 12 9½	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 3 9
1917	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0½
1918	13 15 0	13 17 3	13 17 6	13 17 6	13 17 6	13 17 6	13 17 6	14 15 0	14 15 0	14 15 0	14 15 0	14 15 0	14 4 5
1919	15 10 0	16 5 0	17 15 0	17 15 0	20 15 0	21 0 0	21 0 0	22 0 0	22 0 0	22 0 0	22 7 6	22 12 6	20 1 8
1920	24 7 6	24 10 0	25 10 0	27 10 0	29 5 0	31 0 0	31 10 0	31 10 0	31 10 0	31 10 0	31 10 0	29 7 6	29 1 8
1921	26 17 3	25 0 0	23 0 0	21 0 0	19 0 0	18 5 0	16 0 0	16 0 0	15 14 0	14 0 0	13 6 8	13 0 0	19 4 5½
1922	13 0 0	12 3 9	11 14 0	11 11 10½	11 5 0	11 3 6	11 2 6	11 5 0	10 17 2½	10 16 3	10 13 0	10 12 6	11 7 0½
1923	10 16 10½	11 3 1½	12 2 6	12 8 9	12 11 6	12 1 3	11 15 11½	11 15 0	11 15 0	11 15 0	12 13 6	12 8 3	11 18 10½
1924	12 9 6	12 10 0	12 10 0	12 15 7½	12 17 6	12 17 6	12 17 6	12 17 6	12 17 6	12 14 0	12 12 6	12 12 6	12 14 3½
1925	12 12 6	12 12 6	12 12 6	12 12 6	12 12 6	12 7 6	12 7 6	12 7 6	12 4 6	11 18 6	11 13 9	11 13 0	12 6 2
1926	11 7 9½	11 5 0	11 5 0	11 5 0	11 3 9	11 3 9	11 5 0	12 0 0	13 0 0	*	15 7 6	12 19 0	12 0 2
1927	12 6 3	12 2 6	11 14 0	11 0 0	10 18 9	10 13 6	10 12 6	10 5 0	9 16 0	9 15 0	9 13 9	9 12 9	10 14 2
1928	9 12 6	9 12 6	9 11 0	9 10 0	9 8 4	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 3 6	9 1 3	9 7 0
1929	9 0 0	9 2 6	9 5 7½	9 9 4½	9 10 0	9 17 6	10 2 6	10 2 6	10 2 6	10 0 6	10 3 9	10 5 7	9 15 2½
1930	10 7 6	10 7 6	10 7 6	10 6 10½	10 6 3	10 5 0	10 2 6	10 2 6	10 2 6	10 2 6	10 2 6	10 2 6	10 4 7½
1931	10 2 6	10 0 0	10 0 0	10 0 0	9 18 1½	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 16 10½	9 18 0½
1932	9 15 0	9 15 0	9 15 0	9 15 0	9 13 9	9 11 3	9 10 0	9 10 0	9 10 0	9 6 3	9 5 0	9 5 0	9 10 11½
1933	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0
1934	9 5 0	9 8 1½	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 11 6
1935	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6
1936	9 12 6	9 15 0	10 2 6	10 2 6	10 2 6	10 2 6	10 6 3	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 4 5½

* No quotation available owing to strike.

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

A REALLY prominent Iron Foundry Manager, possessing unimpeachable credentials, is available for re-engagement. Experience covers pipe founding, light castings and machine tools.—Reply Box 166, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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YOUNG Foundryman desires first post as Assistant. Excellent training in high-class general, Diesels, non-ferrous, moulding machines, pattern plates, mechanised; used to lab. routine. Wide outlook and control personality.—Box 172, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOREMAN required to take charge of small bay attached to large ironfoundry. Weekly output of small bay 25 tons of high-class engineering castings up to 2 tons in weight. Only men with first-class experience need apply. State, in confidence, age, experience, and salary required, to Box 162, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

ASSISTANT Foundry Manager desires re-engagement. Experience includes in charge of highly mechanised plant, also general engineering jobbing experience. Fully competent to control metal mixtures, cupola management. Has had some laboratory experience, sound technical training. (293)

PATENT

THE proprietor of British Patent No. 380,502, dated February 24, 1931, relating to "Improvements in Furnaces," is desirous of entering into arrangements by way of a licence, or otherwise on reasonable terms, for the purpose of exploiting the above patent and ensuring its practical working in Great Britain. —Inquiries to B. SINGER, Steger Building, Chicago, Illinois.

TENDER

ARMY CONTRACTS.

NOTICE is hereby given that Tenders for goods and services of the kinds mentioned below are invited from time to time, as required :—

Metal Trades :—

Building materials, Cutlery, Enamelled-ware, Hardware, Hollow-ware, Ironmongery, Machinery and plant, Metals ferrous and non-ferrous, Tinware, Tools, Tubular scaffolding, Vehicles, Wire, Wire rope.

Electrical, Optical and Scientific Instrument Trades :—

Cables, Electrical plant, Electrical and wireless stores, Scientific and optical instruments.

Textile Trades :—

Blankets (brown, grey and red), Braid and lace, Canvas and canvas goods, Clothing (made up from the Department's own materials), Cotton piece goods and cotton goods, Cordage, Flags, Head-dresses, Horse rugs, Hosiery, Linen piece goods, Sewing silk, Shirting (wool and cotton mixture), Silk cloth and webbing, Towels, Woollen cloths.

Foodstuffs, Coal and Coke.

Other Trades :—

Badges and buttons, Basket-ware, Bedding, Boots and shoes, Brooms and brushes, Chemicals and oxygen and acetylene gases, China and earthenware, Furniture, Glazed ware drain pipes, Harness and saddlery, Leather and leather goods, Linoleum, Medical supplies, Moulded rubber articles, Musical instruments, Oils and spirits, Paints and varnishes, Refractories (firebricks, etc.), Road materials, Rubber boots and clothing, Safety glass, Sanitary appliances, Timber, Woodware.

Building Works, etc. :—

Jobbing, painting and repair work (including term contracts), New buildings, Heating and electrical installations, Erection of constructional steelwork, Reinforced concrete work, Road and drainage work, Roofing and flooring work, Construction of sports grounds, etc.

Firms not already on the War Office List of Tenderers, who wish to be invited to tender for the above Army requirements as they arise, should apply in writing to the Director of Army Contracts, Caxton House (West), Tothill Street, Westminster, London, S.W.1, for Form 1 (Form 1A in respect of the services mentioned under Building Works above), on which formal application for inclusion on the list of tenderers may be made. The services of an intermediary are unnecessary in approaching the Department for this purpose.

Before being placed on the lists of tenderers, firms will have to satisfy the Department that they actually manufacture goods or carry out services for which they wish to be noted, and will be required to furnish the names of at least two well-known firms or public bodies who have employed or purchased from them and are in a position to certify as to the quality of their work. They will further have to give an undertaking that they will comply with the Fair Wages Resolution of the House of Commons.

Attention is called to the following resolution passed by both Houses of Parliament on February 16, 1926 :—

> "That, in the opinion of this House, it is the duty of the Government in all Government contracts to make provision for the employment, to the fullest possible extent, of disabled ex-Service men, and to this end to confine such contracts, save in exceptional circumstances, to employers enrolled on the King's National Roll."

Sales.

From time to time the Department has for sale surplus Army Stores of various descriptions, among which may be mentioned Boots, Clothing, Electrical and wireless stores, Chemicals (including drugs, ammonium nitrate and sodium picrate), Hutting, Machinery,

(Continued in next column.)

TENDER—*Continued*

Medical and dental stores, Motor vehicles and spare parts, Optical and scientific instruments, Scrap metals, Textile goods, Veterinary stores.

Firms who wish to be invited to tender for the purchase of surplus stores should apply in writing to the Director of Army Contracts, Caxton House (West), Tothill Street, Westminster, London, S.W.1.

Sales of surplus stores by auction are also held at the Royal Arsenal, Woolwich, about the middle of January, March, May, July, September and November. Catalogues may be obtained from the Chief Ordnance Officer, Royal Arsenal, Woolwich, S.E.18.

No application is necessary from firms whose names are already on the War Office Lists, unless they have extended the range of their manufactures.

H. C. GORDON,
Director of Army Contracts.

MACHINERY

SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. BREALEY & Co., LTD., Station Works, Ecclesfield, Sheffield.

EXCELLENT practically new Sandblast Compressor by Sentinel, 600 cub. ft. capacity, suitable for 50 lbs. working pressure, direct coupled to 76-h.p. 415-v. 3-ph. 50-cy. a.c. motor, speed 293 revs.; complete with Ellison oil-immersed switchgear. Low price to clear prior to installing larger set.—Box 160, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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SEVERAL NEARLY NEW UTARD POWER MOULDING MACHINES. Cheap.

New Brealey type Sand Mixer.	Price,	£25.
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Very good 18-ton Ladle.	Price	£40.

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